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FINAL FEASIBILITY STUDY AT SITE 11 NSWC INDIAN HEAD MD
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NAVFAC CHESAPEAKE

Final

Site 11 Feasibility Study

Naval Support Facility, Indian Head
Indian Head, Maryland

Contract Task Order 051

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Prepared by

Chantilly, Virginia

Executive Summary

This Feasibility Study (FS) addresses potential sources of contamination at Site 11 at the Naval Support Facility, Indian Head (NSF-IH), in Indian Head, Maryland. Site 11, Caffee Road Landfill, includes the landfill area (Area A and the Upland Area) and the adjacent burn pit area (Area B). This report was prepared by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC), Atlantic Division (LANTDIV), Comprehensive Long-term Environmental Action—Navy (CLEAN) III Contract 62470-02-D-3052, Contract Task Order (CTO) 051, for submittal to the U.S. Department of the Navy (Navy), NAVFAC Washington, the U.S. Environmental Protection Agency , and the Maryland Department of the Environment. The activities described herein are part of the overall Installation Restoration Program being implemented by NSF-IH.

This FS documents the analysis and evaluation used to develop remedial action objectives (RAOs) and remedial alternatives (RAs) for Site 11. The information presented in this report will be used by the Navy and regulatory agencies to select an RA for the site that complies with requirements set forth by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

In 2000, a Remedial Investigation (RI) was conducted at Site 11 (CH2M HILL, 2004). The RI concluded that there are potentially unacceptable human health and ecological risks associated with soil, sediment, and groundwater at Site 11. A Baseline Ecological Risk Assessment was conducted to assess potential ecological risk from contaminants in the sediment in the unnamed creek and along the shoreline of Mattawoman Creek (CH2M HILL, 2005a).

This FS addresses the contamination associated with soil and solid waste in Area A and the nearshore sediment along the Mattawoman Creek adjacent to Site 11. Based on information gathered to date, this FS concludes that a remedial action is not required for Area B and that the Upland Area will be addressed with Site 66. This FS does not address the shallow groundwater at Site 11 because none of the detected constituents in the shallow groundwater exceed the federal maximum contaminant levels. Moreover, groundwater at this site is not a potable source and is not expected to be one in the future. Site 11 was previously a wetland that as confirmed by aerial photographs, was filled in to create the existing topography. Thus, the current groundwater is former surface water that became trapped because of the filling-in activity. Consequently, the current groundwater does not meet federal requirements for classification as an aquifer.

Following are the site-specific RAOs developed for Site 11 on the basis of the results of previous investigations and risk assessments:

1. Reduce or minimize human and ecological receptors' direct contact with the solid wastes in the former landfill in Area A.

2. Reduce or minimize exposures to contaminants in soil that presumably pose unacceptable risks to human receptors in Area A.

3. Reduce or minimize potential risk to ecological receptors (i.e., benthic fishes) from sediment.
4. Minimize and control soil erosion and runoff to surface water.

The initial phase of RA evaluation was identification of the general response actions (GRAs) that were capable of achieving the RAOs. A preliminary list of technically feasible remedial technologies and process options was then developed based on the identified GRAs. These technologies and process options were further screened according to cost, effectiveness, and implementability. The retained technologies were then assembled into RAs. The following RAs were identified:

Soil, Solid Waste, and Nearshore Sediment in Area A

- **Alternative 1—No Action:** This alternative is required by NCP as a baseline. Alternative 1 involves no planned actions for soil, solid waste, and/or groundwater.
- **Alternative 2—Protective Soil Cover, Institutional Controls (ICs), and Groundwater Monitoring:** This alternative involves installing a soil cover, regrading the site, stabilizing the shoreline to manage runoff and eliminate human and ecological exposures, implementing ICs, and groundwater monitoring. IC measures include land- and groundwater-use restrictions.
- **Alternative 3—RCRA Equivalent Subtitle C Cap, ICs, and Groundwater Monitoring:** This alternative is similar to Alternative 2 except that a RCRA Equivalent Subtitle C Cap would be installed instead of a soil cover.
- **Alternative 4—Excavation, Offsite Disposal, and Wetland Creation:** This alternative involves excavation of the solid waste and contaminated soil within the landfill area and offsite disposal. The excavation site would be restored as a tidal wetland. No ICs would be anticipated because all solid waste and contaminated soil would be removed from the site.

Implementing Alternatives 2, 3, or 4 will address the nearshore sediment contamination area in Area A.

Nearshore Sediment in Area B

The alternatives include:

- **Alternative 1—No Action**: This alternative is required by NCP as a baseline. Alternative 1 involves no planned actions for sediment.
- **Alternative 2—Long-Term Monitoring and ICs**: This alternative involves long-term sediment monitoring for zinc, and continuous implementation of IC measures, such as prohibiting vessel anchoring, establishing a no-wake zone, etc. The attenuation of zinc concentrations in sediment would depend entirely on natural recovery processes.
- **Alternative 3—*In situ* Capping and ICs**: This alternative involves installing a gravel blanket over the nearshore sediment to contain zinc-contaminated sediment and implementing ICs, such as prohibiting vessel anchoring.

The alternatives were evaluated against the nine criteria defined in the NCP (40 CFR 300). The criteria permit comparison of the relative performance of the alternatives and provide a means to identify their advantages and disadvantages.

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Acronyms and Abbreviations

AA	area of attainment
ARAR	applicable or relevant and appropriate requirement
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action—Navy
cm/sec	centimeters per second
COC	constituent of concern
COMAR	Code of Maryland Regulations
COPC	constituent of potential concern
CY	cubic yards
DP	direct push
ER	Environmental Restoration
ERA	Ecological Risk Assessment
FOD	frequency of detection
FS	Feasibility Study
GRA	General Response Action
HELP	Hydrologic Evaluation of Landfill Performance
HHRA	human health risk assessment
IAS	Initial Assessment Study
IC	institutional control
IHIRT	Indian Head Installation Restoration Team
IRP	Installation Restoration Program
LANTDIV	Atlantic Division (of the Naval Facilities Engineering Command)
MCL	maximum contaminant level
MDE	Maryland Department of the Environment
MEC	munitions and explosives of concern
MEE	methane, ethane, ethene
msl	mean sea level
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NSF-IH	Naval Support Facility, Indian Head
NPL	National Priorities List
NTCRA	non-time-critical removal action
O&M	operation and maintenance
OMB	Office of Management and Budget
PRG	preliminary remediation goal
RA	remedial alternative
RAO	remedial action objectives
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act of 1976
RFA	RCRA Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SERA	Screening Ecological Risk Assessment
SF	square foot
SRG	Site Remediation Goal
TBC	to be considered
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VSI	Visual Site Inspection
XRF	X-Ray fluorescence

SECTION 1

Introduction and Background Information

This report describes the Feasibility Study (FS) for solid waste, surface soil, subsurface soil, groundwater, and sediment that was conducted at Site 11, Caffee Road Landfill, at the Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland. This FS report was prepared by CH2M HILL under the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Atlantic Division (LANTDIV), Comprehensive Long-Term Environmental Action—Navy (CLEAN) III Contract No. N62470-02-D-3052, Contract Task Order 0051. The FS is part of the overall Installation Restoration Program (IRP) being implemented by NSF-IH.

1.1 Objectives

This FS report has been developed in accordance with the Navy's IRP, USEPA guidance (USEPA, 1988), the National Oil and Hazardous Substance Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] 300 et seq.), and other relevant USEPA guidance.

This report uses information gathered from various investigations, described in Section 1.5. These investigations were used as a basis for developing and evaluating cost-effective alternatives to remediate landfill, soil, and groundwater contamination in Area A, solid waste in the Upland Area, and sediment along the shoreline of Mattawoman Creek. The remedial alternatives (RAs) developed in this FS address remedial action objectives (RAOs) and risks associated with Site 11. This report includes a site-specific explanation of how each alternative satisfies the NCP's seven site-specific remedy selection criteria.

In addition, this FS report documents the analyses and evaluations used to develop the RAs for Site 11. The information presented herein will be used by the Navy and regulatory agencies to select an RA for Site 11 that complies with the requirements of the NCP. This report is not intended to serve as a design document; rather, it gives a conceptual overview of RAs and an assessment of their feasibility. The FS report discusses criteria used to evaluate RAs and to determine the effects of implementing them.

1.2 Report Organization

This FS report is composed of the following sections:

- Section 1—Introduction and Background Information
- Section 2—RAOs, Applicable or Relevant and Appropriate Requirements (ARARs), Site Remediation Goals (SRGs), and Areas of Attainment (AAs)
- Section 3—Screening of Remedial Technologies and Development of RAs
- Section 4—Descriptions and Detailed Analysis of RAs
- Section 5—Comparative Analysis of RAs
- Section 6—References

Figures and tables referenced within the text are provided at the end of each section. Appendices referenced within the text are provided at the end of the report.

1.3 Base Location and History

NSF-IH is a naval facility located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, DC (Figure 1-1). The facility occupies an area of approximately 3,500 acres and consists of two tracts of land: the main installation on the Cornwallis Neck Peninsula and the Stump Neck Annex located across the Mattawoman Creek (Figure 1-1). Both the main installation (also known as Cornwallis Neck Peninsula) and the Stump Neck Annex are on the National Priorities List (NPL). Site 11 is located in the southwest corner on the main installation.

NSF-IH is generally surrounded by commercial, residential, and state parkland to the east and south of the main installation and Stump Neck Annex (Figure 1-1). The main installation covers approximately 2,500 acres and is bounded by the Potomac River to the northwest, west, and south; Mattawoman Creek to the south and east; and the town of Indian Head to the northeast. Elevations range from sea level to approximately 125 feet above mean sea level (msl). The town of Indian Head is located just northeast of NSF-IH, where most residential developments are located. Indian Head Highway (Route 210) extends eastward from the NSF-IH main gate, attracting businesses and providing access to residential areas off the main highway. The Potomac River borders the main installation to the north and west and Stump Neck to the west. Mason Neck National Wildlife Refuge is located across the Potomac River, north of the main installation. The state-owned Mattawoman Natural Environment Area is located along the southern edge of the Mattawoman Creek east of the main installation.

Stump Neck Annex covers approximately 1,000 acres and is bordered to the north by Mattawoman Creek, to the east by General Smallwood State Park and Sweden Point Marina, and to the south by Chicamuxen Creek, agricultural lands, and low-density residential development. Elevations range from sea level to approximately 10 feet above msl. The Chicamuxen Wildlife Management Area is located adjacent to and south of the Stump Neck Annex (Figure 1-1).

NSF-IH was established in 1890 and is the Navy's oldest continuously operating ordnance station. At various times during its operation, NSF-IH has served as a gun and armor proving ground, a powder factory, a propellant plant, and a research facility. The U.S. government purchased Stump Neck Annex in 1901. The property provided a safety buffer for the testing of larger naval guns that were tested by firing into the Potomac River and at Stump Neck.

The primary mission of NSF-IH was production of gunpowder and development of new explosives during the onset of World War II. After the Vietnam conflict, the mission of NSF-IH shifted from primarily production to a highly technical engineering support. In 1987, the Naval Ordnance Station was established as a Center for Excellence to promote technological excellence in the following specialized fields: energetic chemicals; guns, rockets, and missile propulsion; ordnance devices; explosives; safety and environmental protection; and simulators and training (Parsons, 2000). Current Navy land use includes operations and training; production; maintenance and utilities; research, development, testing, and evaluation; explosive storage; supply and non-explosive storage; administration; community facilities and services; housing; and open space.

1.4 Background and Site Description

Site 11, Caffee Road Landfill, is situated at the southern end of Caffee Road, extending about 200 feet on either side of the road to the edge of the unnamed creek on the west and to the Mattawoman Creek on the south (Figure 1-2). The landfill is bordered by an unnamed tidal creek and associated wetland to the west and by Mattawoman Creek to the south (Figure 1-1).

A review of historical aerial photographs indicated that Site 11 was primarily created by landfilling activities, which occurred after 1956. Appendix A shows the historical aerial photographs between 1956 and 1987. As shown in the 1956 photograph, Site 11 was at that time mostly in its natural setting, consisting primarily of wetlands, with minimal evidence of man-made activities. The 1963 photograph shows that most of the area within Site 11 had been cleared and filled. Furthermore, the historical aerial photos indicated that filling activities have extended the shoreline into Mattawoman Creek as much as 150 feet from its original position. Site reconnaissance by two CH2M HILL ecologists in September 2002 verified that much of the Mattawoman Creek shoreline next to Site 11 consists of concrete, debris, and fill.

The landfill was used until the early 1960s for the disposal of bulk metal items and trash, rocket motor casings, exploded building debris, rifles, demilitarized ordnance, propellant grains residue, and open burning residues (Fred C. Hart Associates, Inc., 1983). There is no information concerning the date when the landfill was first used. In 1980, NSF-IH reportedly removed 5,000 to 6,000 cubic yards of "flashed" metal parts from this wetland area. Flashed metal refers to metal debris that was burned to remove trace amounts of explosives residue. "Treated" metal debris was placed in a pile, and approximately 15 gallons of diesel fuel were poured over the waste as fuel source (CH2M HILL, 2004). The Initial Assessment Study (IAS) indicated that various materials were dumped or left uncovered for extended periods (Fred C. Hart Associates, Inc., 1983). The site was never permitted as a landfill, so there were no cover material application procedures to secure deposited or stored waste materials. The surface covering the landfill had been used until recently as the Caffee Road Thermal Treatment Point Pad, where a large collection of flashed metal parts was stored. The metal parts were removed periodically by a metal-recycling contractor. With the exception of a new gravel pad, which is now the Caffee Road Thermal Treatment Point Pad, the landfill area was regraded and seeded in 2001.

The Remedial Investigation (RI) initially focused on the landfill, designated as Area A on Figure 1-2. A literature search conducted at NSF-IH during the RI revealed that four open-burning pits previously existed along the eastern edge of Site 11. This area was designated as Area B and was investigated as part of the RI. Two incinerators, located on the eastern side of Site 11, were also present in Area B. One was a chemical incinerator (Building 1549) that reportedly was never used and the other was an incinerator for classified documents (Building 1607) (Figure 1-2).

For the purpose of this FS, Site 11 has been divided into three areas, as shown on Figure 1-2, because these areas have different historical uses. Site 11 now includes the landfill (Area A and the Upland Area) and the burn pit area (Area B). Past landfilling and disposal activities occurred at Area A and the Upland Area and incineration or waste burning occurred at Area B. The original burn location was just west of IH-02 (as shown in Figure 1-2). Burning in this area stopped when the area was cleaned up and regraded in 2001.

1.5 Previous Investigations

Several investigations were conducted at Site 11 between 1983 and 2005. Below is a chronological description of each of these investigations.

1.5.1 Initial Assessment Study (IAS)

The objective of the IAS (Fred C. Hart Associates, Inc., 1983) was to identify and assess sites posing a threat to human health or to the environment because of contamination from past hazardous materials operation. The IAS identified Site 11 as Caffee Road Landfill based on reported disposal of bulk items and trash and observations of uncontrolled spills, uncovered and leaking drums, and dust covering site vegetation. The IAS did not recommend a Confirmation Study.

1.5.2 Phase II RCRA Facility Assessment (RFA)

A Phase II Resource Conservation and Recovery Act (RCRA) Facility Assessment (A.T. Kearny, Inc., 1988) was conducted by USEPA and consisted of a preliminary review of available documents and a visual site inspection (VSI), which was conducted July 11-15, 1988.

Site 11 was visited during the VSI, but the team did not observe uncontrolled spills or uncovered and leaking drums, as noted in the IAS. However, a large collection of flashed metal parts was observed at the site.

1.5.3 Remedial Investigation

There was no sampling conducted at this site up to this point. Therefore, sampling of various media was conducted in 2000 and 2002 as part of the RI conducted at Site 11 and four other sites (CH2M HILL, 2004). Field activities for the RI report were conducted in two phases. Initial RI field activities were conducted between July 20 and August 9, 2000. The objectives were to determine: (1) the extent and thickness of waste at the site, (2) whether the waste was a source of contamination to soils and groundwater, (3) whether soils have been impacted, and (4) whether the adjacent creeks have been impacted. Field activities consisted of surface and subsurface soil sampling, waste sampling, sediment and surface water sampling, direct push (DP) groundwater sampling, and monitoring well installation and sampling.

Follow-up RI field activities were conducted between February 25 and March 26, 2002, on the eastern portion of the site (the former burning grounds). The objectives of the follow-up RI activities were to determine: (1) whether environmental media have been impacted by former burning pits in this area, (2) whether waste is present in the area east of Building

1607, (3) the extent and thickness of waste, if present, and (4) whether environmental media have been impacted from past land use in the area between Building 1607 and the former burning pits. Field activities consisted of surface and subsurface soil sampling, sediment and surface water sampling, and monitoring well installation and sampling. Figure 1-3 presents the locations of soil, groundwater, sediment, and surface water samples. The complete analytical results of the RI samples are included as Appendix B. Detailed descriptions of the nature and extent of constituents detected in each medium is presented in Section 4.4 of the RI report.

The results of both investigations are presented in the RI report. The lateral and vertical extent of the solid waste area was determined based on the presence of the earthen fill material that was used to reclaim the land and the debris and solid waste in the soil borings. It was further determined that much of the solid waste lies below the water table; the solid waste and subsurface soil samples had similar types of semivolatile organic compounds , metals, and explosives, suggesting that the waste has penetrated the soil. However, there were few constituents in groundwater, indicating that the solid waste has not severely affected the groundwater quality.

As part of the RI, a baseline human health risk assessment (Baseline HHRA) and a Screening Ecological Risk Assessment (SERA) were also performed for Site 11. The HHRA and SERA activities are summarized in Section 1.7 of this report. Detailed descriptions of the baseline HHRA and SERA are presented in Sections 4.6 and 4.7 of the RI report, respectively.

1.5.4 Baseline Ecological Risk Assessment

A Baseline Ecological Assessment (BERA) was performed for Sites 11 and 17 as these sites abut one another, share similar physical characteristics, and are hydrologically connected to Mattawoman Creek. The BERA was performed for both sites because the results of the SERA (Steps 1-3A of the Ecological Risk Assessment [ERA]) indicated potentially unacceptable risks to ecological receptors from exposures to the soil at both sites and the sediment along the Mattawoman Creek. No unacceptable risk to ecological receptors was identified in surface water along the perimeter of the site. The BERA evaluated sediment in the unnamed creek and Mattawoman Creek adjacent to Sites 11 and 17. Soil from the landfill and the Upland Area was not evaluated because the landfill will be capped, and the Partnering Team agreed that soils at Site 11 that pose a potentially unacceptable ecological risk would be removed and placed under the cap during cap construction. The placement of contaminated soils under the cap will also address potential risks from surface runoff from the site to Mattawoman Creek.

Investigation activities for the BERA were conducted in August 2004. The activities involved collection of sediment, benthic invertebrates, and fish samples. Groundwater contamination was not evaluated directly in the BERA, but any contribution from discharge to the sediments was evaluated in the investigation of sediment toxicity to the benthic community. The locations of the sediment samples are shown in Figure 1-3. The results indicated that conditions in the unnamed creek pose an unacceptable risk to benthic invertebrates, but evidence suggests that the risk is not related to COCs from Sites 11 and 17. However, there is the potential for an unacceptable risk to epibenthic fishes from zinc in some sediment areas along the shoreline of Site 11. The likely source for the zinc contamination in the nearshore sediment is the metal debris littered within the Site 11 shoreline. Detailed results are presented in the BERA report (CH2M HILL, 2005a).

1.5.5 Wetland Delineation

On February 10, 2005, CH2M HILL performed jurisdictional wetland delineations at Site 11. This field survey was conducted to assist NSF-IH in avoiding and/or minimizing, to the greatest extent practicable and feasible, potential impacts to wetlands and water bodies resulting from future capping or excavation within Site 11.

Two potential wetland areas were identified, Area One (IH-01) and Area Two (IH-02). IH-01 is within the western corner of, and adjacent to Area A, while IH-02 is entirely within Area A. No wetlands were observed in Area B. Figure 1-2 shows the locations of IH-01 and IH-02.

IH-01, which encompasses a total area of 1.59 acres, is classified under the National Wetlands Inventory wetland classification scheme as an estuarine intertidal emergent wetland; it is divided into two distinct areas, intertidal and freshwater. Approximately 0.23 acre of IH-01 falls within the Site 11 boundary. This portion will be addressed as part of the remedy for Site 11. H-02 is a palustrine emergent freshwater wetland and is approximately 0.10 acre in area. It is located within Area A along Mattawoman Creek. This area serves as a drainage basin for the upper grassy fields and the paved access road. This small freshwater area was the result of construction activities conducted at the site in 2001.

The areas are classified in accordance with the U.S. Corps of Engineers (USACE) wetlands delineation manual (USACE, 1987). IH-01 is classified as a jurisdictional wetland based on its vegetation, hydrology, and hydric soil. IH-02 is considered an atypical wetland subject to a jurisdictional call by USACE and the Maryland Department of Environment (MDE). A technical memorandum presenting a detailed discussion of the wetland delineation at Site 11 is provided as Appendix C.

1.5.6 Topographic Survey

In May and July 2005, Patton Harris Rust Associates conducted a land topographic survey at Site 11 because the surface elevation contours used in the Final RI report were based on a survey conducted in 1999 and did not reflect the current land topographical condition. After the 1999 survey, the Navy regraded part of the site between April and October 2001 to prevent potentially contaminated storm water runoff from entering Mattawoman Creek.

1.5.7 Geophysical Survey

Comments from MDE on the draft FS report (CH2M HILL, 2005b) indicated that, per MDE's policy, Environmental Article of Annotated Code of Maryland Title 9, Subtitle 204, waste cannot be consolidated under a soil cover unless it is a RCRA cap. MDE further indicated that the lateral extent of the solid waste area used to define the area requiring remediation in the draft FS must be refined because of the absence of solid waste material in some portions of the area.

In May 2006, Earth Resource Technology of Columbia, Maryland performed a geophysical survey north and east of the proposed cover area using electromagnetic conductivity, ground-penetrating radar, and ground resistivity to identify subsurface anomalies, which may indicate previous disturbances and waste placement. The results of the geophysical survey were used in the FS to refine the extent of the solid waste area that requires remediation. Appendix D presents the results and interpretation of the geophysical survey.

1.5.8 Hydrographic Survey

In November 2007, CR Environmental of East Falmouth, Massachusetts, performed a hydrographic survey in Mattawoman Creek approximately 130 to 180 feet from the shoreline adjacent to Site 11. The objectives of the hydrographic survey were to obtain sediment elevations, identify magnetic anomalies, identify areas with surface debris, and map water current velocities in the survey area using bathymetry, side-scan sonar, magnetometer, and current surveys. The results of the hydrographic survey are used to develop the conceptual design and estimate the cost of shoreline stabilization measures for this FS and calculate design parameters such as slope stability analysis, and calculate the particle size of the *in situ* sediment cap for the design phase of the remedy. Appendix E presents the results and interpretation of the hydrographic survey.

1.6 Site Characteristics

This section summarizes the geologic and hydrogeologic characteristics of Site 11. Detailed discussions on these subjects are presented in the *Final Remedial Investigation Report, Sites 11, 13, 17, 21, and 25* (herein referred to as RI report) (CH2M HILL, 2004).

1.6.1 Geology and Extent of Solid Waste

The lateral and vertical extent of solid waste and the subsurface geology at Site 11 were defined based on the results of 38 soil borings and 8 monitoring wells installed as part of the RI from 2000 through 2002. Following the initial field investigation in Area A and before the additional investigation in Area B, the Navy excavated, regraded, and seeded Site 11, specifically Area A, in 2001. The regrading resulted in changes to the topography in Area A, which was not taken into consideration in estimating the thickness of the fill in the RI report.

Figure 1-4 illustrates the interpreted subsurface profiles at the cross-sections (A-A′, B-B′, C-C′, and D-D′) shown in Figure 1-3. Figure 1-5 depicts the estimated thickness and areal extent of the solid waste before the 2001 regrading (this figure is taken from the RI report). In 2005, a topographic survey of Area A was completed and the thickness of the fill was adjusted to account for the change in topography since the RI field activities. Figure 1-6 shows the current extent and thickness of fill.

As shown on Figure 1-6, most of the soil borings in the central and western portion of Area A encountered fill material in the shallow subsurface (down to a depth of 4 feet below ground surface [bgs]). Fill was encountered to depths greater than 10 feet bgs in the center of the landfill. In Area A, the fill appears to be bounded to the east approximately 75 feet east of Building 1551, to the west approximately 45 feet east of the unnamed creek, to the north approximately 30 to 75 feet south of the northern boundary of the site, and to the south approximately 20 feet north of Mattawoman Creek.

Fill was also encountered in the Upland Area. In Area A and the Upland Area, the fill is characterized by clayey sands and gravels containing solid waste (wood fragments, concrete, bricks, glass, ash, and slag). The fill is underlain by Quaternary deposits characterized by sandy and clayey silts with thin clay lenses. At the bottom of soil boring IS11MW05, a clay layer greater than 5 feet thick was encountered at 28 feet bgs (Figure 1-6).

The extent of the solid waste in Area A was further refined using the results of the geophysical survey performed in May 2006. As described in Appendix D.1, the extent of the solid waste in the northern portion of Area A is limited to the immediate area within the geophysical anomalies. East of Area A, the geophysical results are contrary to the RI results, which suggested that the thickness of solid waste ranged from 0 to 4 feet. Figure 1-7 shows the extents of the solid waste area based on the RI soil borings and the results of the geophysical survey.

In Area B, shallow soils (approximately 2 to 4 feet bgs) are characterized by sandy silty clay with organic matter (e.g., roots). The sand ranges from fine- to medium-grained. Some fill material was encountered in the southwestern portion of Area B contiguous to the fill layer from Area A. The average thickness of fill was about 2 feet. Area B was never used as a disposal area; rather, it was briefly used as an incineration site for classified documents. Thus, the minimal presence of fill in Area B is a result of incidental deposit.

1.6.2 Hydrogeology

Figure 1-8 presents the potentiometric surface map for Site 11. Water levels used for creating the contours were measured in the eight monitoring wells on March 20, 2002. The water table elevations range from 1.89 feet above msl at IS11MW01, located along the shoreline, to 8.42 feet above msl at IS11MW05, located upgradient of Site 11. Groundwater flow is generally from north to south towards Mattawoman Creek and perhaps towards the unnamed creek. The cross-sections on Figure 1-4 show that the fill/solid waste extends below the water table over most of the landfill area.

Mattawoman Creek is influenced by the tides and, in turn, it is likely that the site water table, at least near the creek, is as well. Typically, when an aquifer is influenced by tidal cycles, the water table or potentiometric surface will fluctuate in a harmonic motion consistent with the tides. The amplitude (or height) of the fluctuation decreases as the distance from the shoreline increases. The time lag between high tide and water level high also will increase with increasing distance from the shore. An evaluation was not performed to quantify the effects of the tidal cycle on the water table at Site 11. However, a tidal study was performed between April 5, 2002 and May 5, 2002 at Site 17, which is adjacent to Site 11. The results of the tidal study are presented in a technical memorandum, *Pre-Feasibility Study Field Activities and Results, Site 17, Indian Head Division-NSWC, Indian Head, Maryland* (CH2M HILL, 2002). No field tests were performed at the site to estimate the hydraulic conductivity of the natural subsurface materials.

1.7 Summary of Risk Assessments

This section summarizes the results of the HHRA and ERA.

1.7.1 Human Health Risk Assessment

This section summarizes information from the Baseline HHRA that was presented in the RI report and the Area B HHRA that was presented in the technical memorandum, *Human*

Health Risk Evaluation, Site 11, NDWIH, Indian Head, Maryland (CH2M HILL, 2005c), submitted to the Indian Head Installation Restoration Team (IHIRT) on July 12, 2005, and included as Appendix F.

1.7.1.1 RI Report Baseline Human Health Risk Assessment

Section 4.6 in the RI report presents a detailed discussion of the Baseline HHRA performed for Site 11. Soil (surface and subsurface), groundwater, sediment, and surface water were sampled and analyzed. The analytical results from each medium were used as one data population representing all areas of Site 11 in the Baseline HHRA. Table 4-15 in the RI report presents a summary of constituents of potential concern (COPCs) retained for each medium sampled. Tables 4-16 and 4-17 in the RI report provide the exposure pathways identified and the risks summary, respectively.

The receptor scenarios evaluated during the Baseline HHRA are:

Current Use Receptors

- Surface Soil—Industrial worker and Trespasser/Visitor (adult and adolescent)
- Surface Water—Recreational User (adult and child)
- Sediment—Recreational User (adult and child)

Future Use Receptors

- Combined Surface and Subsurface Soil—Construction Worker, Industrial Worker, Trespasser/Visitor (adult and adolescent), and Resident (adult and child)
- Surface Water—Recreational User (adult and child)
- Sediment—Recreational User (adult and child)
- Shallow Groundwater—Construction Worker and Resident (adult and child).

The following constituents were identified as the COCs, referred to as HHRA COCs (Table 1-1):

- Soil: aluminum, antimony, arsenic, cadmium, chromium, copper, manganese, nickel, silver, thallium, and vanadium

- Groundwater: aluminum, antimony, arsenic, barium, chromium, iron, manganese, nickel, and vanadium

The HHRA COCs are defined as constituents that pose individual carcinogenic risks greater than 1×10^{-6} and contribute to cumulative carcinogenic risks greater than 1×10^{-4} or an individual noncarcinogenic hazard of greater than 0.1 and cumulative target-organ-specific noncarcinogenic hazards of greater than 1.0.

1.7.1.2 Area B Human Health Risk Assessment

In 2005, an HHRA was performed only for Area B. The rationale for the risk assessment is presented in Appendix F. Consistent with the Baseline HHRA, the same receptor scenarios and exposure pathways were evaluated for Area B. The Area B HHRA focused primarily on evaluating risks associated with exposures to soil (surface and subsurface) and groundwater.

Detailed results of the Area B HHRA are presented in Appendix F. Tables 1 and 2 of Appendix F-1 summarize the potential risks for each exposure scenario associated with Area B soil and groundwater, respectively.

The HHRA COCs in Area B are (Table 1-1):

- Soil: aluminum, antimony, arsenic, cadmium, chromium, copper, manganese, thallium, and vanadium
- Groundwater: antimony, arsenic, and manganese

As shown in Table 1-1, the COCs for both soil and groundwater at Area B are fewer than those identified in the Baseline HHRA.

The technical memorandum outlining the results of Area B HHRA (Appendix F-1) further concluded that there are no presumptively unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil because the soil COC concentrations are either below the risk-based preliminary remediation goals (PRGs), later described in Section 2.5, or are below or consistent with the facility-wide background concentrations. In Area B shallow groundwater, the COC concentrations are either less than or consistent with background conditions. For these reasons, remedial actions are not necessarily required for either soil or groundwater at Area B.

1.7.2 Ecological Risk Assessment

During the SERA (Step 1 through Step 3a), presented in the RI report (CH2M HILL, 2004), several inorganic constituents in sediment and soil were selected as COPCs because they would pose a risk to soil invertebrates, plants, insectivorous birds and mammals, carnivorous terrestrial birds, and piscivorous birds. In addition, polycyclic aromatic hydrocarbons and explosives in sediment along a 300-foot stretch of Mattawoman Creek may pose a risk to benthic invertebrates and aquatic plants., Based on preliminary reviews of concentration distribution, a BERA (Step 3b and Step 4) was performed in 2005 to assess potential ecological risk from COPCs along the shoreline and in the unnamed creek adjacent to Site 11. The BERA resulted in the identification of the following:

- Conditions in the unnamed creek pose an unacceptable risk to benthic invertebrates, but evidence suggests that the risk is not related to COPCs from Sites 11 and 17.
- Zinc in nearshore sediments at Sites 11 and 17 poses a potentially unacceptable risk to epibenthic fishes. However, the benthic invertebrate community is relatively healthy 20 to 30 feet offshore and not adversely affected by site-related chemicals.

Because the risk in the unnamed creek is not related to COPCs from Site 11, and it is believed that the source of contamination in the unnamed creek is upstream (Site 66), remediation of this area will not be addressed in this FS report, but rather in a separate installation restoration action to include the upstream source. However, the contamination in the unnamed creek will be taken into consideration during development of the RAs because of the creek’s proximity to Site 11.

The results of the 2005 BERA demonstrated that zinc in the nearshore sediments at Site 11 is bioaccumulating in the tissues of small fish inhabiting the shoreline area. The concentration of zinc found in the fish tissue poses a potentially unacceptable risk to at least one fish species. For this reason, zinc was identified as the only COC for the sediment at Site 11. The likely source for the zinc contamination in the nearshore sediment was the metal debris littered within the Site 11 shoreline. Contributions of the surface runoff and groundwater discharging to the creek to the sediment contamination were also evaluated but did not represent dominant sources.

1.8 FS Constituents of Concern

1.8.1 Identification of FS COCs

The final COCs to be addressed in the FS, referred to as FS COCs, were identified based on the human health risk-driving COCs (HHRA COCs) and ecological risk-driving COCs.

Figure 1-13 describes the process for selecting the FS COCs from the HHRA COCs. The first step for determining the FS COCs is to determine the COPCs. During the HHRA, COPCs were identified by comparing the maximum detected chemical concentrations, primarily in soil and groundwater, to USEPA's residential soil and tap water risk-based concentrations (RBCs), respectively (USEPA, 2005a). The noncarcinogenic effect RBC values were adjusted by dividing the values by 10 to account for exposure to multiple constituents. Constituents with maximum detected concentrations above the adjusted RBCs were retained as COPCs.

The second screening step was to define COPCs that pose individual carcinogenic risks greater than 1×10^{-6} and contribute to cumulative carcinogenic risks greater than 1×10^{-4} or an individual non-carcinogenic hazard of greater than 0.1 and cumulative target-organ-specific non-carcinogenic hazards of greater than 1.0. These COPCs are referred to as the HHRA COCs (shown in Table 1-1).

In the third step, HHRA COCs were compared to base-wide background concentrations (Tetra Tech NUS, 2002). If the concentration of an HHRA COC exceeded the background value, the constituent was considered to be a COC. Table 1-2 compares the maximum detected concentrations of the HHRA COCs and the base-wide background concentrations for the soil and shallow groundwater at Site 11. The FS COCs for Site 11 soil are aluminum, antimony, arsenic, barium, cadmium, chromium, copper, manganese, nickel, silver, and zinc. The FS COCs for the shallow groundwater are antimony, barium, manganese, and silver. Table 1-2 shows the FS COCs based on human health risk-driving COCs for Area A and the Upland Area and Area B. As shown in Table 1-2, none of the groundwater final COCs exceeded the federal maximum contaminant levels (MCLs).

The BERA results indicate that the likely source for the zinc contamination in the nearshore sediment was the metal debris littered within the Site 11 shoreline, potentially serving as a continuing source for the zinc contamination. For this reason, zinc has been identified as the only ecological risk-driving COC for Site 11 and was carried forward as one of the FS COCs.

1.8.2 Extent of COCs

This section summarizes the extent of solid waste and the nature and extent of constituents found in soil (surface and subsurface), surface water, groundwater, and sediment of Site 11, focusing on the FS COCs identified during the risk assessment (Section 1.7). Soil and groundwater concentrations are compared to the facility-wide background concentrations presented in Tables 4-2 and A-4, respectively, in the *Background Soil Investigation Report for Indian Head and Stump Neck Annex* (herein referred to as Background Report; Tetra Tech NUS, Inc., 2002) and provided as Appendix E in the RI Report. For sediment, the background concentrations were taken from the Mattawoman Creek study (Tetra Tech NUS, Inc., 2004). As noted in previous sections, all COCs are metals. Complete analytical results of detected constituents in the surface and subsurface soil and groundwater at Site 11 can be found in Appendix B of this report and the final RI report. Detailed descriptions of the detections of other constituents can be found in the final RI report.

1.8.2.1 Soil

Eleven inorganic COCs in surface and subsurface soil were identified in the Baseline and Area B HHRAs and the BERA as a consequence of the past disposal and incineration practices over time. These COCs include aluminum, antimony, arsenic, cadmium, chromium, copper, iron, manganese, silver, thallium, vanadium, and zinc. Figure 1-9 and 1-10 depicts select COC detections in the surface and subsurface soil at Site 11. For simplification, concentrations of COC that were below facility-wide background concentrations and considered isolated detections are not shown in these figures. Tables 1-3 and 1-4 provide the complete lists of detected constituents and their frequency of detection (FOD) in the surface and subsurface soil in Area A and the Upland Area. The list of detections of constituents in the surface and subsurface soil in Area B are shown in Tables 1-5 and 1-6, respectively.

Within Area A, generally the highest COC concentrations and the largest number of detections in the surface soil were encountered in samples collected around Building 24 (IS11SS15, IS11SS16, and IS11SS17) and in the western and central parts of the sampled area at the site (IS11SS23, IS11SS26, IS11SS27, and IS11SS31). Samples collected along the northwest and northern parts of the site and in the eastern part of the sampled area of the site had among the lowest concentrations of metals, except for a high detection of iron along the eastern edge of the sampled area at the site. The largest concentrations of most metals in the subsurface soil were detected in sample IS11SB04, collected near the center of the site. Essentially, the COCs in Area A soil correspond with the boundary of solid waste.

Within Area B, generally the highest COC concentrations and the largest number of detections in the surface soil were encountered in samples located from directly north of Building 1607 to Mattawoman Creek on the eastern side of the sampled area (IS11SS44, IS11SS48, and IS11SS51). The highest concentrations of most metals in the subsurface soil were detected in sample IS11SB44, collected at the location of a former burning pit.

Aluminum was detected in all 49 surface soil and all 17 subsurface soil sample locations. Twelve of the 49 surface soil samples were detected at concentrations exceeding the base-wide background concentration of 11,500 milligrams per kilogram (mg/kg). The maximum concentration, 25,600 mg/kg, was detected in the sample obtained from surface soil sample location IS11S026 (sample IS11SS26), in the central portion of Area A. Three subsurface soil samples contained aluminum at concentrations exceeding the background concentration.

Antimony was detected at 27 of the 49 surface soil sample locations. Twenty-one of the surface soil samples were detected at concentrations exceeding the base-wide soil background concentration of 1.8 mg/kg. The maximum concentration detected in surface soil, 18.9 mg/kg, was detected in surface soil samples obtained from sample locations IS11SO17 and IS11S031. Antimony was detected at 6 of the 17 subsurface soil sample locations; 4 of those were detected at concentrations exceeding the base-wide background concentration of 1.8 mg/kg. The maximum concentration detected in subsurface soil, 4.4 mg/kg, was detected in the sample obtained from the IS11S051 sample location, in the central portion of Area B.

Arsenic was detected at 48 of the 49 surface soil sample locations. It was detected at eight sample locations with concentrations exceeding the base-wide background concentration of 18.3 mg/kg (Tetra Tech NUS, 2002). The maximum detected concentration, 42.7 mg/kg, was obtained from the IS11SS26 sample location, in the central portion of Area A. Arsenic was detected in samples obtained from all 17 subsurface soil sampling locations. One sample exceeded the base-wide background concentration of 18.3 mg/kg. The maximum detected concentration, 21.1 mg/kg, was obtained from the IS11S051 sample location, in the central portion of Area B.

Cadmium was detected at 43 of the 49 surface soil sample locations. It was detected at 37 sample locations with concentrations exceeding the base-wide background concentration of 0.18 mg/kg. The maximum detected concentration, 147 mg/kg, was obtained from the IS11SS27 sample location, in the west central portion of Area A. Cadmium was detected in 13 out of 17 subsurface soil samples; 9 of those at were detected concentrations exceeding the base-wide background concentration of 0.18 mg/kg. The maximum detected sample concentration, 9 mg/kg, was obtained from the IS11S049 sample location, in the southwestern portion of Area B.

Chromium was detected in all of the 49 surface soil sample locations; 12 of those were detected at concentrations exceeding the base-wide background concentration of 46.5 mg/kg. The maximum detected concentration, 156 mg/kg, was obtained from the IS11S026 sample location, in the central portion of Area A. Chromium was also detected in all samples collected from 17 subsurface soil sampling locations; however, the concentrations did not exceed the base-wide background concentration of 46.5 mg/kg. The maximum detected concentration, 41.5 mg/kg, was obtained from the IS11S044 sample location, in the east-central portion of Area B.

Copper was detected in all 49 surface soil samples; 30 of those were detected at concentrations exceeding the base-wide background concentration of 25.9 mg/kg. The maximum detected concentration, 4,960 mg/kg, was obtained from the IS11SO24 sample location, in the northeastern portion of Area A. Copper was also detected in all 17 subsurface soil samples; 6 of those were detected at concentrations exceeding the base-wide soil background concentration of 25.9 mg/kg. The maximum detected concentration, 690 mg/kg, was obtained from the IS11S044 sample location, in the east-central portion of Area B.

Manganese was detected in all 49 surface soil samples; 27 of those concentrations exceeded the base-wide background concentration of 266 mg/kg. The maximum detected concentration, 1,330 mg/kg, was obtained from the IS11SO10 sample location, in the east-central portion of Area A. Manganese was also detected in all 17 subsurface soil samples; 3 of which exceeded the base-wide background concentration of 266 mg/kg. The maximum detected concentration, 368 mg/kg, was obtained from the IS11S053 sample location, in the northeast corner of Area B.

Silver was detected in 36 out of 49 surface soil samples; 25 of which exceeded the base-wide background concentration of 2.2 mg/kg. The maximum detected concentration, 62.5 mg/kg, was obtained from the IS11S031 sample location, in the west-central portion of Area A. Silver was detected in 12 out of 17 subsurface soil samples; 5 of those were detected at concentrations exceeding the base-wide background concentration of 62.5 mg/kg. The maximum detected concentration of 9.2 mg/kg was observed in IS11S044 sample location, in the east-central portion of Area B.

Thallium was detected in 10 out of 49 surface soil samples; however, all detections were at concentrations below the base-wide background concentration of 6 mg/kg. The maximum detected concentration, 5.5 mg/kg, was obtained from the IS11S022 sample location, in the north-central portion of Area A. Thallium was detected in two out of seven subsurface soil samples; both at concentrations (1.3 and 1.4 mg/kg) below the base-wide background concentration of 6 mg/kg. The IS11S040 sample area is located in the wooded area, approximately 130 feet west of West Caffee Road and 215 feet south of Building 1649. The IS11S041 sample area is located approximately 290 feet north of Area A and approximately 80 feet east of Building 1650.

Vanadium was detected in all 49 surface soil samples; however, no concentrations exceeded the base-wide background concentration of 127 mg/kg. The maximum detected concentration, 60.2 mg/kg, was obtained from the IS11SO31 sample location, in the west central portion of Area A. Vanadium was also detected in all 17 subsurface soil samples; however, all detections were at concentrations below the base-wide background concentration of 127 mg/kg. The maximum detected concentration, 38.3 mg/kg, was obtained from the IS11S049 sample location, in the south western portion of Area B.

Zinc was detected in all 49 surface soil samples; 32 of those concentrations exceeded the base-wide background concentration of 70.4 mg/kg. The maximum detected concentration, 10,000 mg/kg, was obtained from the IS11SO10 sample location, in the east-central portion of Area A. Zinc was also detected in all 17 subsurface soil samples; 6 of those were detected at concentrations exceeding the base-wide background concentration of 70.4 mg/kg. The maximum detected concentration, 1,120 mg/kg, was obtained from the IS11S044 sample location, in the east-central portion of Area B.

1.8.2.2 Surface Water

Based on the results of the Baseline HHRA and the BERA, no COCs were identified for Site 11 surface water.

1.8.2.3 Groundwater

Nine inorganic COCs in groundwater were identified in the HHRA and the BERA; only three of those were for Area B. These COCs include aluminum, antimony, arsenic, barium, chromium, iron, manganese, nickel, and vanadium. Figure 1-11 depicts the total and dissolved metal COC detections, respectively; excluding COCs that were in general below background concentrations and considered isolated detections. The complete list of detected constituents and their FOD for Area A (and the Upland Area) and Area B are shown in Tables 1-7 and 1-8, respectively.

The detected concentrations were in general within the same order of magnitude between the monitoring well and DP groundwater samples. Total metal concentrations were generally an order of magnitude or greater than the corresponding dissolved concentrations in the DP groundwater samples. Total and dissolved metal concentrations were comparable in the monitoring well groundwater samples.

As in the Final Background Investigation Report (Tetra Tech NUS, 2002) and the RI reports, the discussion of metal concentrations in groundwater is focused on sample results obtained from groundwater monitoring wells, because the DP samples were used more for screening and not to represent human health risks. In general, the largest concentrations of iron and manganese were found on the eastern side of Site 11, including locations MW03, MW08, MW07, and MW06. Elevated concentrations of other COC metals were intermittent throughout the site.

Total aluminum was detected in seven out of eight groundwater samples; two of those (IS11MW04 and IS11MW05, with total aluminum concentrations of 31,400 and 10,700 micrograms per liter [µg/L]) were detected at concentrations exceeding the base-wide background concentration of 9,620 µg/L. Dissolved aluminum was only detected in the sample obtained from IS11MW05 at concentration of 1,330 µg/L, below the base-wide background concentration of 9,620 µg/L.

Total antimony was detected in samples obtained from four of the eight groundwater monitoring wells. Antimony was not detected in the background samples (Tetra Tech NUS, 2002). The maximum concentration of total antimony was detected in the sample obtained from groundwater monitoring well IS11MW02, with a concentration of 4.2 µg/L. Dissolved antimony was only detected in the samples obtained from groundwater monitoring wells IS11MW02 and IS11MW07, with concentrations of 5 µg/L and 2.8 µg/L.

Total arsenic was detected in four out of eight groundwater samples. Arsenic was not detected in the background samples. The maximum concentration of total arsenic was detected in the sample obtained from groundwater monitoring well IS11MW04, with a concentration of 4.2 µg/L. Dissolved arsenic was only detected in three out of the eight groundwater samples, with the maximum concentration of 5.1 µg/L observed in groundwater monitoring well IS11MW02.

Total barium was detected in all eight groundwater samples at concentrations exceeding the base-wide background concentration of 139 µg/L, with the maximum concentration of 1,680 µg/L observed in monitoring well IS11MW01. Dissolved barium was also detected in all eight groundwater samples; however, only four of those samples contained barium at concentrations exceeding the facility background concentration. As with total barium, the maximum concentration of dissolved barium, 1,630 µg/L, was also detected in the sample obtained from groundwater monitoring well IS11MW01.

Total chromium was detected in all eight groundwater samples; two of those were detected at concentrations exceeding the base-wide background concentration of 16.4 µg/L. The maximum concentration of total chromium was detected in the sample obtained from groundwater monitoring well IS11MW04, with a concentration of 59.6 µg/L. Dissolved chromium was only detected in four out of the eight groundwater samples; however, none of those samples contained chromium at concentrations exceeding the base-wide background concentration. The maximum concentration of dissolved chromium, 9.2 µg/L, was detected in the sample obtained from groundwater monitoring well IS11MW05.

Total iron was detected in all eight groundwater samples; five of those were detected at concentrations exceeding the base-wide background concentration of 19,900 µg/L. The maximum concentration of total iron was detected in the monitoring well IS11MW04 sample at concentration of 51,000 µg/L. Dissolved iron was detected in seven out of eight groundwater samples; four of which contained iron at concentrations exceeding the base-wide background concentration. The maximum concentration of dissolved iron, 43,600 µg/L, was detected in the sample obtained from groundwater monitoring well IS11MW08.

Total manganese was detected in all eight groundwater samples; six of those were detected at concentrations exceeding the base-wide background concentration of 824 µg/L. The maximum concentration of total manganese was detected in the sample obtained from groundwater monitoring well IS11MW08, with a concentration of 3,020 µg/L. Dissolved manganese was detected in all eight groundwater samples; five samples contained manganese at concentrations exceeding the facility background concentration. The maximum concentration of dissolved manganese, 3,010 µg/L, was also detected in the sample obtained from groundwater monitoring well IS11MW08.

Total nickel was detected in all eight groundwater samples; two of those were detected at concentrations exceeding the base-wide background concentration of 16.6 µg/L. The maximum concentration was detected in the sample from monitoring well IS11MW04, with a concentration of 110 µg/L. Dissolved nickel was detected in six out of eight groundwater samples; only one of which was detected at concentration exceeding the base-wide background concentration. The maximum concentration of dissolved nickel, 58 µg/L, was detected in the sample obtained from groundwater monitoring well IS11MW04.

Total vanadium was detected in seven out of eight groundwater samples; two of those at concentrations exceeding the base-wide background concentration of 20.9 µg/L. The maximum concentration was detected in the sample from monitoring well IS11MW04, with a concentration of 55.4 µg/L. Dissolved vanadium was detected in three out of eight groundwater samples; none of which were detected at concentrations exceeding the base-wide background concentration. The maximum concentration of dissolved vanadium, 2.6 µg/L, was detected in the sample from monitoring well IS11MW05.

1.8.2.4 Sediment

Zinc has been identified in the BERA as the COC for sediment at Site 11, as well as Site 17. It was detected in all six sediment sample locations identified in the BERA at concentrations ranging from 90.6 to 370 mg/kg. Only four of these samples contained zinc at concentrations exceeding the Mattawoman Creek Study maximum background concentration of 108 mg/kg (Table 4-2; Tetra Tech NUS, Inc., 2004). The maximum concentration, 370 mg/kg, was detected in the sample obtained from sample location IS11SD03. Additionally, it should be noted that results from samples obtained from locations IS11SD05, IS11SD06, and IS11SD07 were not included in this study because they are attributable to Site 66, which is upgradient of Site 11, but they will be included in a separate study.

The zinc concentrations in the BERA samples, collected 20–30 feet offshore in 2004, were 60 to 90 percent lower in zinc concentrations (average concentration of 200 mg/kg) than the samples collected at the shoreline in 2000 (average concentration of 847 mg/kg). Zinc contamination in the sediment is most likely attributable to the scattered metal debris in the shoreline and the surface runoff from the Area A and Area B to much lesser extent. This can account for the contrast in zinc concentrations between the samples obtained in 2000 and 2004.

The cursory evaluation of zinc concentrations in groundwater indicated that the contribution of the groundwater-to-sediment pathway is minimal. Figure 1-12 depicts the extent of zinc concentration in sediment.

TABLE 1-1
Baseline HHRA and the Area B HHRA – Determination of HHRA COCs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Constituent	Data						Calculated HI for Future Child Resident				HHRA COCs			
	Background		**Site 11 EPC**		**Area B EPC**		**Site 11**		**Area B**		**Site 11**		**Area B**	
	Soil	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**
Aluminum	11,500	73,400	10,721	31,400	10,850	NA	0.14	2.0	0.14	NA	Yes	Yes	Yes	No
Antimony	1.8	ND	7.6	4.7	7.3	2.9	0.27	0.76	0.28	0.48	Yes	Yes	Yes	Yes
Arsenic	18	19	15	8.2	15	2.9	0.68	1.8	0.71	0.62	Yes	Yes	Yes	Yes
Barium	101	688	NA	1,680	NA	NA	NA	1.6	NA	NA	No	Yes	No	No
Cadmium	0.18	9.8	145	NA	11	NA	2.0	NA	0.15	NA	Yes	No	Yes	No
Chromium	46.5	191	41	60	59	NA	0.30	1.4	0.53	NA	Yes	Yes	Yes	No
Copper	26	166	1,669	NA	467	NA	0.55	NA	0.15	NA	Yes	No	Yes	No
Manganese	266	2,290	486	2,637	392	3,020	0.50	8.5	0.43	11	Yes	Yes	Yes	Yes
Nickel	18	166	43	110	NA	NA	0.04	0.37	NA	NA	Yes	Yes	No	No
Silver	2.2	ND	29	NA	NA	NA	0.11	NA	NA	NA	Yes	No	No	No
Thallium	6.0	ND	1.3	NA	5.2	NA	0.23	NA	0.98	NA	Yes	No	Yes	No
Vanadium	127	281	26	55	26	NA	0.58	3.9	0.69	NA	Yes	Yes	Yes	No
Zinc	70	483	2,986	NA	NA	NA	0.13	NA	NA	NA	Yes	No	No	No

NOTES:
Units for concentrations in soil and groundwater are mg/kg and μg/L.
EPC = Exposure Point Concentration
NA = Not applicable because the constituent was not identified as a COPC.

TABLE 1-2
Summary of FS COCs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

COC	Surface and Subsurface Soil (mg/kg)			Groundwater (µg/L)			
	Background	Max Detect	Final COC	Background	Max Detect	MCL	Final COC
Area A and Upland Area							
Aluminum	11,500	25,600	Yes	73,400	31,400	NA	No
Antimony	1.8	19	Yes	ND	4.2	6.0	Yes
Arsenic	18.3	43	Yes	19.1	8.2	10	No
Barium	101	367	Yes	688	1,680	2,000	Yes
Cadmium	0.18	147	Yes	9.8	0.71	5	No
Chromium	46.5	156	Yes	191	60	100	No
Copper	25.9	4,960	Yes	166	34	1,300	No
Iron	21,700	263,000	Yes	252,000	51,000	NA	No
Manganese	266	1,330	Yes	2,290	2,570	NA	Yes
Nickel	18.2	189	Yes	166	110	NA	No
Silver	2.2	62.5	Yes	ND	6.1	NA	Yes
Thallium	6.0	5.5	No	ND	ND	2	No
Vanadium	127	60	No	281	55.4	NA	No
Zinc	70	10,000	Yes	483	217	NA	No
Area B							
Aluminum	11,500	23,400	Yes	73,400	NA	NA	No
Antimony	1.8	9.5	Yes	ND	2.9	6.0	Yes
Arsenic	18.3	25	Yes	19.1	2.9	10	No
Cadmium	0.18	20	Yes	9.8	NA	5	No
Chromium	46.5	151	Yes	191	NA	100	No
Copper	25.9	1,380	Yes	166	NA	1,300	No
Iron	21,700	130,000	Yes	252,000	44,700	NA	No
Manganese	266	733	Yes	2,290	3,020	NA	Yes
Thallium	6.0	5.2	No	ND	NA	2	No

Note:

The background data for soil are taken from Table 4-1 in Section 4.0 and for groundwater from Table A-4 in Appendix A in Tetra Tech NUS's 2004 report "Background Soil Investigation Report.

TABLE 1-3
Frequency of Detections in Area A Surface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs								
Acetone	0.0031	J	0.065	J	MG/KG	IS11SS340001	4/24	0.011 - 0.033
Cyclohexane	0.0036	J	0.0036	J	MG/KG	IS11SS420001	1/24	0.011 - 0.033
Ethylbenzene	0.0024	J	0.0024	J	MG/KG	IS11SS400001	1/24	0.011 - 0.033
Methyl acetate	0.0015		0.016	UJ	MG/KG	IS11SS310001 IS11SS330001P	8/24	0.011 - 0.033
Toluene	0.0016		0.14	J	MG/KG	IS11SS400001	4/24	0.011 - 0.033
Trichloroethene	0.0016	J	0.0096	J	MG/KG	IS11SS330001P	2/24	0.011 - 0.033
Xylene, total	0.0017	J	0.0099	J	MG/KG	IS11SS420001	3/24	0.011 - 0.033
cis-1,3-Dichloropropene	0.018	J	0.018	UJ	MG/KG	IS11SS250001 IS11SS350001	1/24	0.011 - 0.033
trans-1,3-Dichloropropene	0.018	J	0.018	UJ	MG/KG	IS11SS250001 IS11SS350001	1/24	0.011 - 0.033
SVOCs								
2-Methylnaphthalene	0.05	J	0.13	J	MG/KG	IS11SS310001	4/24	0.37 - 1.1
Acenaphthene	0.078	J	0.25	J	MG/KG	IS11SS310001	4/24	0.37 - 1.1
Acetophenone	0.057	J	0.71		MG/KG	IS11SS210001	9/24	0.37 - 1.1
Anthracene	0.045	J	0.54	J	MG/KG	IS11SS290001	9/24	0.37 - 1.1
Benzaldehyde	0.047	J	0.37	J	MG/KG	IS11SS210001	10/24	0.37 - 1.1
Benzo(a)anthracene	0.066	J	2.7		MG/KG	IS11SS310001	17/24	0.37 - 1.1
Benzo(a)pyrene	0.047	J	0.86	J	MG/KG	IS11SS310001	15/24	0.37 - 1.1
Benzo(b)fluoranthene	0.17	J	4.3		MG/KG	IS11SS310001	17/24	0.37 - 1.1
Benzo(k)fluoranthene	0.061	J	1.5		MG/KG	IS11SS290001	17/24	0.37 - 1.1
Butylbenzylphthalate	0.086	J	0.096	J	MG/KG	IS11SS230001	2/24	0.37 - 1.1
Carbazole	0.085	J	0.21	J	MG/KG	IS11SS310001	4/24	0.37 - 1.1
Chrysene	0.11	J	2.9		MG/KG	IS11SS310001	17/24	0.37 - 1.1
Di-n-butylphthalate	0.082	J	0.29	J	MG/KG	IS11SS220001	5/24	0.37 - 1.1
Di-n-octylphthalate	0.59	L	0.59	L	MG/KG	IS11SS250001	1/24	0.37 - 1.1
Dibenz(a,h)anthracene	0.047	J	0.59	J	MG/KG	IS11SS310001 IS11SS250001	10/24	0.37 - 1.1
Dibenzofuran	0.065	J	0.13	J	MG/KG	IS11SS310001	3/24	0.37 - 1.1
Diethylphthalate	0.046	J	0.15	J	MG/KG	IS11SS190001	3/24	0.37 - 1.1
Fluoranthene	0.065	J	5		MG/KG	IS11SS290001	19/24	0.37 - 1.1
Fluorene	0.047	J	0.59		MG/KG	IS11SS250001	6/24	0.37 - 1.1
Hexachlorobenzene	0.59		0.59		MG/KG	IS11SS250001	1/24	0.37 - 1.1
Hexachlorobutadiene	0.59		0.59		MG/KG	IS11SS250001	1/24	0.37 - 1.1
Indeno(1,2,3-cd)pyrene	0.07	J	0.99	J	MG/KG	IS11SS310001	16/24	0.37 - 1.1
Naphthalene	0.052	J	0.065	J	MG/KG	IS11SS230001	2/24	0.37 - 1.1
Phenanthrene	0.053	J	2.3		MG/KG	IS11SS290001	16/24	0.37 - 1.1
Phenol	0.16	J	0.16	J	MG/KG	IS11SS210001	1/24	0.37 - 1.1
Pyrene	0.06	J	2.1		MG/KG	IS11SS290001	18/24	0.37 - 1.1
bis(2-Ethylhexyl)phthalate	0.071	J	3.3		MG/KG	IS11SS330001P	16/24	0.37 - 1.1
Explosives								
n-Nitrosodiphenylamine	0.066	J	0.13	J	MG/KG	IS11SS290001	3/24	0.37 - 1.1
2,4,6-Trinitrotoluene	0.36		0.36		MG/KG	IS11SS260001	1/24	0.25 - 0.25
2,6-Dinitrotoluene	0.09	J	0.098	J	MG/KG	IS11SS270001P	2/24	0.25 - 0.25
2-Amino-4,6-dinitrotoluene	0.13	J	0.13	J	MG/KG	IS11SS260001	1/24	0.25 - 0.25
2-Nitrotoluene	0.15	J	0.17	J	MG/KG	IS11SS250001	2/24	0.25 - 0.39
4-Amino-2,6-dinitrotoluene	0.17	J	0.17	J	MG/KG	IS11SS260001	1/24	0.25 - 1.2
4-Nitrotoluene	0.21	J	0.21	J	MG/KG	IS11SS400001	1/19	0.25 - 0.25
HMX	0.22	J	3.7		MG/KG	IS11SS260001	3/24	0.5 - 0.5
Perchlorate	0.11		480		MG/KG	IS11SS260001	3/24	0.0046 - 0.0046
RDX	0.19	J	0.86		MG/KG	IS11SS270001P	4/24	0.5 - 0.91

TABLE 1-3

Frequency of Detections in Area A Surface Soil

Site 11 Feasibility Study

NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
Metals						
Aluminum	3,960 J	25,600	MG/KG	IS11SS260001	24/24	4.2 - 12.4
Antimony	1.1 UL	18.9 L	MG/KG	IS11SS310001	13/23	0.97 - 2.8
Arsenic	1.7 L	42.7 L	MG/KG	IS11SS260001	24/24	0.81 - 2.4
Barium	7.9 J	286	MG/KG	IS11SS290001	24/24	0.09 - 0.26
Beryllium	0.049	0.5 J	MG/KG	IS11SS390001	3/24	0.045 - 0.13
Cadmium	0.12 J	147 J	MG/KG	IS11SS270001	20/24	0.09 - 0.26
Calcium	176 J	184,000 J	MG/KG	IS11SS340001	22/24	1.8 - 5.4
Chromium	3.6 L	156 L	MG/KG	IS11SS260001	24/24	0.45 - 1.3
Cobalt	2.2 J	14.3	MG/KG	IS11SS270001	22/24	0.49 - 1.5
Copper	2.1 J	4,960 J	MG/KG	IS11SS240001	24/24	0.43 - 1.3
Cyanide	0.09 J	0.66	MG/KG	IS11SS390001	12/24	0.56 - 3
Iron	5,680	212,000 J	MG/KG	IS11SS240001	24/24	6.1 - 38.6
Lead	2.6 J	132,000	MG/KG	IS11SS220001	24/24	0.3 - 29.2
Magnesium	256 J	11,500	MG/KG	IS11SS270001	24/24	3 - 8.8
Manganese	17.4	892 L	MG/KG	IS11SS270001	24/24	0.09 - 0.26
Mercury	0.066 J	8.6 J	MG/KG	IS11SS290001	19/24	0.056 - 0.17
Nickel	1.2 J	157	MG/KG	IS11SS270001P	23/24	0.43 - 1.3
Potassium	95.7 J	1,290 J	MG/KG	IS11SS260001	24/24	11.8 - 34.6
Selenium	1.1 UL	1.2	MG/KG	IS11SS400001 IS11SS240001P	3/24	0.97 - 2.8
Silver	0.81	62.5	MG/KG	IS11SS310001	17/24	0.7 - 2.1
Sodium	115	2,120 J	MG/KG	IS11SS340001	9/24	98.6 - 290
Thallium	1.3 J	5.5	MG/KG	IS11SS220001	7/24	1.2 - 3.5
Vanadium	3.7 J	60.2	MG/KG	IS11SS310001	24/24	0.31 - 0.92
Zinc	12.4 J	8,820 J	MG/KG	IS11SS270001	24/24	0.14 - 1.6
TPH						
TPH-diesel range	4.8	400	MG/KG	IS11SS310001	23/24	3.4 - 99
TPH-gas range	0.17	0.24	MG/KG	IS11SS190001	3/24	0.11 - 0.33

TABLE 1-4
Frequency of Detections in Area A Subsurface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs								
2-Butanone	0.0043	J	0.0043	J	MG/KG	IS11SB040608	1/6	0.012 - 0.014
Acetone	0.0026	J	0.017		MG/KG	IS11SB040608	2/6	0.012 - 0.014
Cyclohexane	0.0023	J	0.0023	J	MG/KG	IS11SB090102	1/6	0.012 - 0.014
Toluene	0.0033	J	0.0033	J	MG/KG	IS11SB230203	1/6	0.012 - 0.014
Xylene, total	0.0024	J	0.009	J	MG/KG	IS11SB240203	2/6	0.012 - 0.014
SVOCs								
Acetophenone	0.048	J	0.048	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Benzo(a)anthracene	0.063	J	0.063	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Benzo(b)fluoranthene	0.11	J	0.11	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Chrysene	0.076	J	0.076	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Diethylphthalate	0.043	J	0.043	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Fluoranthene	0.12	J	0.12	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Phenanthrene	0.049	J	0.049	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
Pyrene	0.048	J	0.048	J	MG/KG	IS11SB040608	1/6	0.39 - 0.45
bis(2-Ethylhexyl)phthalate	0.047	J	0.89		MG/KG	IS11SB040608	2/6	0.39 - 0.45
Explosives								
1,3-Dinitrobenzene	0.032	J	0.032	J	MG/KG	IS11SB260203	1/6	0.25 - 0.25
Metals								
Aluminum	4,530		17,900	J	MG/KG	IS11SB250203	6/6	4.4 - 5.1
Arsenic	1.7	J	6.8	L	MG/KG	IS11SB230203	6/6	0.84 - 0.98
Barium	36.7	J	85		MG/KG	IS11SB040608	6/6	0.094 - 0.11
Beryllium	0.28	J	0.39	J	MG/KG	IS11SB260203	2/6	0.047 - 0.055
Cadmium	0.095		0.17		MG/KG	IS11SB090102	4/6	0.094 - 0.11
Calcium	75.4	J	1,780	J	MG/KG	IS11SB040608	4/6	1.9 - 2.2
Chromium	6.8		20		MG/KG	IS11SB040608	6/6	0.47 - 0.55
Cobalt	3.6	J	14		MG/KG	IS11SB040608	6/6	0.52 - 0.6
Copper	3.9	J	57	J	MG/KG	IS11SB040608	6/6	0.44 - 0.52
Cyanide	0.59		0.68		MG/KG	IS11SB250203	3/6	0.59 - 2.5
Iron	7,850	J	36,800		MG/KG	IS11SB250203	6/6	6.4 - 7.4
Lead	5.5	K	58.1	J	MG/KG	IS11SB040608	6/6	0.3 - 0.35
Magnesium	501	J	2,980		MG/KG	IS11SB040608	6/6	3.1 - 3.7
Manganese	15.9	J	346	L	MG/KG	IS11SB040608	6/6	0.094 - 0.11
Mercury	0.078	L	0.18	L	MG/KG	IS11SB250203	2/6	0.059 - 0.068
Nickel	3.9	J	23.5		MG/KG	IS11SB040608	6/6	0.44 - 0.52
Potassium	353	J	653	J	MG/KG	IS11SB250203	5/6	12.3 - 14.3
Selenium	1	UL	1.2		MG/KG	IS11SB250203	2/6	1 - 1.2
Silver	0.73		3.2	J	MG/KG	IS11SB040608	4/6	0.73 - 0.85
Sodium	103		120		MG/KG	IS11SB250203	3/6	103 - 120
Thallium	1.3		1.4		MG/KG	IS11SB250203	2/6	1.2 - 1.4
Vanadium	11.1	J	31.7		MG/KG	IS11SB250203	6/6	0.33 - 0.38
Zinc	17.4	J	126	K	MG/KG	IS11SB040608	6/6	0.14 - 0.16
TPH								
TPH-diesel range	31		31		MG/KG	IS11SB040608	1/6	3.5 - 7.5

TABLE 1-5
Frequency of Detections in Area B Surface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs								
Acetone	0.005	J	0.005	J	MG/KG	IS11SS520001	1/11	0.012 - 0.032
Bromomethane	0.002	J	0.002	J	MG/KG	IS11SS500001 IS11SS530001	4/11	0.012 - 0.032
Chloromethane	6.00E-04	J	7.00E-04	J	MG/KG	IS11SS500001	2/11	0.012 - 0.032
Cyclohexane	8.00E-04	J	8.00E-04	J	MG/KG	IS11SS510001	1/11	0.012 - 0.032
Methylene chloride	8.00E-04	J	0.002	J	MG/KG	IS11SS430001 IS11SS440001P	5/11	0.012 - 0.032
SVOCs								
2-Methylnaphthalene	0.014	J	0.014	J	MG/KG	IS11SS510001	1/11	0.4 - 1.1
Acenaphthene	0.02	J	0.037	J	MG/KG	IS11SS450001	3/11	0.4 - 1.1
Acenaphthylene	0.011	J	0.068	J	MG/KG	IS11SS450001	5/11	0.4 - 1.1
Anthracene	0.011	J	0.2	J	MG/KG	IS11SS440001P	7/11	0.4 - 1.1
Benzaldehyde	0.009	J	0.03	J	MG/KG	IS11SS530001	6/11	0.4 - 1.1
Benzo(a)anthracene	0.054	J	0.5	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Benzo(a)pyrene	0.056	J	0.46	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Benzo(b)fluoranthene	0.09	J	0.64	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Benzo(g,h,i)perylene	0.061	J	0.37	J	MG/KG	IS11SS450001	5/11	0.4 - 1.1
Benzo(k)fluoranthene	0.072	J	0.6		MG/KG	IS11SS440001P	7/11	0.4 - 1.1
Carbazole	0.013	J	0.076	J	MG/KG	IS11SS450001	4/11	0.4 - 1.1
Chrysene	0.079	J	0.66	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Di-n-butylphthalate	0.035	J	0.035	J	MG/KG	IS11SS440001	1/11	0.4 - 1.1
Di-n-octylphthalate	0.016	J	0.14	J	MG/KG	IS11SS490001	4/11	0.4 - 1.1
Dibenz(a,h)anthracene	0.018	J	0.17	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Dibenzofuran	0.013	J	0.019	J	MG/KG	IS11SS510001	2/11	0.4 - 1.1
Diethylphthalate	0.038	J	0.14	J	MG/KG	IS11SS440001	2/11	0.4 - 1.1
Dimethyl phthalate	0.38	J	0.38	J	MG/KG	IS11SS440001	1/11	0.4 - 1.1
Fluoranthene	0.009	J	0.96	J	MG/KG	IS11SS440001P	10/11	0.4 - 1.1
Fluorene	0.026	J	0.049	J	MG/KG	IS11SS450001	3/11	0.4 - 1.1
Indeno(1,2,3-cd)pyrene	0.043	J	0.39	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Naphthalene	0.012	J	0.018	J	MG/KG	IS11SS510001	2/11	0.4 - 1.1
Phenanthrene	0.024	J	0.46	J	MG/KG	IS11SS450001	7/11	0.4 - 1.1
Pyrene	0.077	J	0.85	J	MG/KG	IS11SS440001P	7/11	0.4 - 1.1
Explosives								
Nitroglycerin	27		27		MG/KG	IS11SS440001P	1/11	10 - 10
Perchlorate	1.4		1.4		MG/KG	IS11SS470001 IS11SS470001P	1/11	0.08 - 0.16
Metals								
Aluminum	6,100		23,400		MG/KG	IS11SS480001	11/11	46.62 - 80.808
Antimony	0.39	L	9.5	L	MG/KG	IS11SS440001P	7/11	13.986 - 24.242
Arsenic	2.4	K	25.5		MG/KG	IS11SS480001	10/11	2.331 - 4.04
Barium	35.8	J	127		MG/KG	IS11SS440001P	11/11	46.62 - 80.808
Beryllium	0.21	J	0.61	J	MG/KG	IS11SS480001	11/11	1.166 - 2.02
Cadmium	0.11	J	20.4		MG/KG	IS11SS510001	9/11	1.166 - 2.02
Calcium	168	J	8,130		MG/KG	IS11SS450001	11/11	1165.5 - 2020.2
Chromium	11.8		151	J	MG/KG	IS11SS510001	11/11	2.331 - 4.04
Cobalt	3.6	J	15.5		MG/KG	IS11SS510001	11/11	11.655 - 20.202
Copper	8.1	J	1,380	K	MG/KG	IS11SS480001	11/11	5.828 - 10.101
Iron	14,500		130,000		MG/KG	IS11SS510001	11/11	23.541 - 46.62
Lead	10.7		1,240		MG/KG	IS11SS440001P	11/11	0.699 - 1.212
Magnesium	539	J	1,800	J	MG/KG	IS11SS450001	11/11	1165.5 - 2020.2
Manganese	55.3		733	L	MG/KG	IS11SS510001	11/11	3.497 - 6.061

TABLE 1-5

Frequency of Detections in Area B Surface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
Mercury	0.09 J	0.41	MG/KG	IS11SS510001	6/11	0.084 - 0.202
Nickel	6.5 J	77.7 J	MG/KG	IS11SS510001	11/11	9.324 - 16.162
Potassium	380 J	795 J	MG/KG	IS11SS480001	11/11	1165.5 - 2020.2
Selenium	0.99 J	5.7	MG/KG	IS11SS510001	11/11	1.166 - 2.02
Silver	0.56 J	10.4	MG/KG	IS11SS440001P	8/11	2.331 - 4.04
Sodium	198 J	3,430	MG/KG	IS11SS480001	11/11	1165.5 - 2020.2
Thallium	5.2 L	5.2 L	MG/KG	IS11SS510001	1/6	2.331 - 4.04
Vanadium	19.8	30.2	MG/KG	IS11SS430001	11/11	11.655 - 20.202
Zinc	23.4	1,990 K	MG/KG	IS11SS480001	11/11	4.662 - 8.081

TABLE 1-6

Frequency of Detections in Area B Subsurface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs						
Acetone	0.013	0.048 J	MG/KG	IS11SB490002P	4/9	0.011 - 0.016
Bromomethane	0.002 J	0.002 J	MG/KG	IS11SB530002	1/9	0.011 - 0.016
Carbon disulfide	1.00E-03 J	1.00E-03 J	MG/KG	IS11SB490002P	1/9	0.011 - 0.016
Cyclohexane	1.00E-03 J	1.00E-03 J	MG/KG	IS11SB480002	1/9	0.011 - 0.016
Methylene chloride	9.00E-04 J	0.003 J	MG/KG	IS11SB440002	4/9	0.011 - 0.016
Trichloroethene	9.00E-04 J	9.00E-04 J	MG/KG	IS11SB510002	1/9	0.011 - 0.016
SVOCs						
2-Methylnaphthalene	0.012 J	0.067 J	MG/KG	IS11SB510002	4/9	0.38 - 0.54
Acenaphthene	0.017 J	0.068 J	MG/KG	IS11SB440002	2/9	0.38 - 0.54
Acenaphthylene	0.028 J	0.31 J	MG/KG	IS11SB440002	4/9	0.38 - 0.54
Anthracene	0.029 J	0.42 J	MG/KG	IS11SB440002	5/9	0.38 - 0.54
Benzaldehyde	0.008 J	0.047 J	MG/KG	IS11SB440002	8/9	0.38 - 0.54
Benzo(a)anthracene	0.021 J	1.4	MG/KG	IS11SB440002	6/9	0.38 - 0.54
Benzo(a)pyrene	0.021 J	1.1	MG/KG	IS11SB440002	7/9	0.38 - 0.54
Benzo(b)fluoranthene	0.018 J	1.5	MG/KG	IS11SB440002	7/9	0.38 - 0.54
Benzo(g,h,i)perylene	0.066 J	0.6	MG/KG	IS11SB440002	5/9	0.38 - 0.54
Benzo(k)fluoranthene	0.023 J	1.1	MG/KG	IS11SB440002	6/9	0.38 - 0.54
Butylbenzylphthalate	0.011 J	0.011 J	MG/KG	IS11SB510002	1/9	0.38 - 0.54
Carbazole	0.017 J	0.08 J	MG/KG	IS11SB440002	4/9	0.38 - 0.54
Chrysene	0.03 J	1.4	MG/KG	IS11SB440002	6/9	0.38 - 0.54
Di-n-octylphthalate	0.012 J	0.16 J	MG/KG	IS11SB510002	3/9	0.38 - 0.54
Dibenz(a,h)anthracene	0.033 J	0.36 J	MG/KG	IS11SB440002	5/9	0.38 - 0.54
Dibenzofuran	0.009 J	0.036 J	MG/KG	IS11SB440002	2/9	0.38 - 0.54
Diethylphthalate	0.018 J	0.37 J	MG/KG	IS11SB510002	2/9	0.38 - 0.54
Fluoranthene	0.014 J	2.9	MG/KG	IS11SB440002	7/9	0.38 - 0.54
Fluorene	0.013 J	0.088 J	MG/KG	IS11SB440002	2/9	0.38 - 0.54
Indeno(1,2,3-cd)pyrene	0.018 J	0.75	MG/KG	IS11SB440002	7/9	0.38 - 0.54
Naphthalene	0.013 J	0.036 J	MG/KG	IS11SB510002	4/9	0.38 - 0.54
Phenanthrene	0.016 J	0.6	MG/KG	IS11SB440002	6/9	0.38 - 0.54
Pyrene	0.027 J	2.2	MG/KG	IS11SB440002	7/9	0.38 - 0.54
bis(2-Ethylhexyl)phthalate	4.5 D	4.5 D	MG/KG	IS11SB520406	1/9	0.38 - 1.2
Metals						
Aluminum	4,770	14,800	MG/KG	IS11SB440002	9/9	43.021 - 63.979
Antimony	0.4 L	4.4 L	MG/KG	IS11SB510002	5/9	12.906 - 19.194
Arsenic	2.3 K	21.1 K	MG/KG	IS11SB510002	9/9	2.151 - 3.199
Barium	53.8	127	MG/KG	IS11SB490002P	9/9	43.021 - 63.979
Beryllium	0.26 J	0.83 J	MG/KG	IS11SB500608	9/9	1.076 - 1.599
Cadmium	0.23 J	9	MG/KG	IS11SB490002P	7/9	1.076 - 1.599
Calcium	234 J	35,600	MG/KG	IS11SB490002P	9/9	1075.53 - 1599.46
Chromium	9.5 J	41.5 J	MG/KG	IS11SB440002	9/9	2.151 - 3.199
Cobalt	4.3 J	11 J	MG/KG	IS11SB530002	9/9	10.755 - 15.995
Copper	5.8 J	690 J	MG/KG	IS11SB440002	9/9	5.378 - 7.997
Iron	7,190	27,300	MG/KG	IS11SB440002	9/9	21.511 - 31.989
Lead	9.3	742	MG/KG	IS11SB490002	9/9	0.645 - 0.96

TABLE 1-6

Frequency of Detections in Area B Subsurface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
Magnesium	373	J	2,390		MG/KG	IS11SB490002	9/9	1075.53 - 1599.46
Manganese	55.8	L	368	L	MG/KG	IS11SB530002	9/9	3.227 - 4.798
Mercury	0.07	J	0.36		MG/KG	IS11SB440002	7/9	0.078 - 0.124
Nickel	5.3	J	29	J	MG/KG	IS11SB440002	9/9	8.604 - 12.796
Potassium	231	J	650	J	MG/KG	IS11SB500608	9/9	1075.53 - 1599.46
Selenium	0.86	J	2.1		MG/KG	IS11SB440002	9/9	1.076 - 1.599
Silver	0.21	J	9.2		MG/KG	IS11SB440002	7/9	2.151 - 3.199
Sodium	202	J	1,870		MG/KG	IS11SB440002	9/9	1075.53 - 1599.46
Vanadium	17		38.3		MG/KG	IS11SB490002	9/9	10.755 - 15.995
Zinc	21.5		1,120		MG/KG	IS11SB440002	9/9	4.302 - 6.398
TPH								
TPH-diesel range	5.6	J	51		MG/KG	IS11SB440002	4/9	11 - 16

TABLE 1-7

Frequency of Detections in Area A Shallow Groundwater
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Unit	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs								
1,1,1-Trichloroethane	4.5	J	4.5	J	µg/L	IS11MW040900	1/5	10 - 10
1,1-Dichloroethane	3.8	J	3.8	J	µg/L	IS11MW040900	1/5	10 - 10
1,1-Dichloroethene	2.6	J	2.6	J	µg/L	IS11MW040900	1/5	10 - 10
Chloroethane	3.8	J	3.8	J	µg/L	IS11MW010900	1/5	10 - 10
Methyl acetate	5	J	5	J	µg/L	IS11MW030900P	1/5	10 - 10
SVOCs								
Toluene	18		18		µg/L	IS11MW030900P	1/5	10 - 10
4-Methylphenol	23		23		µg/L	IS11MW030900	1/4	10 - 10
1,3-Dinitrobenzene	0.064	J	0.066	J	µg/L	IS11MW050900	2/4	0.2 - 0.2
2,4-Dinitrotoluene	0.16	J	0.16	J	µg/L	IS11MW030900P	1/4	0.2 - 0.2
2,6-Dinitrotoluene	0.11	J	0.11	J	µg/L	IS11MW030900P	1/4	0.2 - 0.2
2-Nitrotoluene	0.15	J	0.15	J	µg/L	IS11MW050900	1/4	0.2 - 0.29
3-Nitrotoluene	0.15	J	0.15	J	µg/L	IS11MW040900	1/4	0.2 - 1.4
4-Nitrotoluene	0.15	J	0.37		µg/L	IS11MW030900	2/4	0.2 - 0.2
Explosives								
RDX	0.16	J	0.16	J	µg/L	IS11MW040900	1/4	0.5 - 0.5
Tetryl	0.12	J	0.12	J	µg/L	IS11MW040900	1/4	0.2 - 0.2
Total Metals								
Aluminum	1,350	J	31,400	J	µg/L	IS11MW040900	4/5	18.8 - 19.9
Antimony	3.7	J	4.2	J	µg/L	IS11MW020900	2/5	3.1 - 4.3
Arsenic	4	J	8.2	J	µg/L	IS11MW040900	3/5	3.2 - 3.6
Barium	237	J	1,680	J	µg/L	IS11MW010900	5/5	0.15 - 0.4
Beryllium	1.1	J	1.1	J	µg/L	IS11MW050900	1/5	0.08 - 0.2
Cadmium	0.71	J	0.71	J	µg/L	IS11MW050900	1/5	0.25 - 0.4
Calcium	6,340	J	85,400	J	µg/L	IS11MW030900	5/5	7.7 - 8.2
Chromium	1.1	J	59.6	J	µg/L	IS11MW040900	5/5	1.1 - 2
Cobalt	1	J	59.7	J	µg/L	IS11MW040900	4/5	0.83 - 2.2
Copper	1.4	J	33.9		µg/L	IS11MW040900	5/5	1.3 - 1.9
Cyanide	10.1	L	10.1	L	µg/L	IS11MW010900	1/5	10 - 10
Iron	8,590	L	51,000	L	µg/L	IS11MW040900	5/5	16 - 27.3
Lead	6.1		78.6		µg/L	IS11MW010900	5/5	1.3 - 1.9
Magnesium	4,600		35,600		µg/L	IS11MW010900	5/5	13.4 - 14.2
Manganese	188		2,570		µg/L	IS11MW030900	5/5	0.15 - 0.4
Mercury	0.1		0.1		µg/L	IS11MW010900 IS11MW020900	2/5	0.1 - 0.1
Nickel	2		110		µg/L	IS11MW040900	5/5	1.9 - 2
Potassium	2,190		41,200		µg/L	IS11MW020900	5/5	19.5 - 52.4
Silver	2.1	J	6.1	J	µg/L	IS11MW010900	2/5	1.1 - 3.1
Sodium	26,100	J	98,400	J	µg/L	IS11MW010900	5/5	244 - 439
Vanadium	2.2	J	55.4	J	µg/L	IS11MW040900	4/5	0.76 - 1.4
Zinc	39.9	J	217	J	µg/L	IS11MW040900	5/5	0.6 - 1.2
Dissolved Metals								
Aluminum	1,330		1,330		µg/L	IS11MW050900	1/5	18.8 - 19.9
Antimony	5	J	5	J	µg/L	IS11MW020900	1/5	3.1 - 4.3
Arsenic	5.1	J	5.1	J	µg/L	IS11MW020900	1/5	3.2 - 3.6
Barium	24.5	J	1,630		µg/L	IS11MW010900	5/5	0.15 - 0.4
Cadmium	0.47	J	0.62	J	µg/L	IS11MW040900	2/5	0.25 - 0.4

TABLE 1-7

Frequency of Detections in Area A Shallow Groundwater
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Unit	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
Calcium	1,960 J	84,700	µg/L	IS11MW030900P	5/5	7.7 - 8.2
Chromium	9.2 J	9.2 J	µg/L	IS11MW050900	1/5	1.1 - 2
Cobalt	1 J	35 J	µg/L	IS11MW040900	3/5	0.83 - 2.2
Iron	2,040	35,300	µg/L	IS11MW030900P	4/5	16 - 27.3
Magnesium	1,290 J	34,500	µg/L	IS11MW010900	5/5	13.4 - 14.2
Manganese	90.3 J	2,590	µg/L	IS11MW030900P	5/5	0.15 - 0.4
Nickel	2.6 J	58	µg/L	IS11MW040900	3/5	1.9 - 2
Potassium	578 J	42,200	µg/L	IS11MW020900	4/5	19.5 - 52.4
Sodium	29,900	94,800	µg/L	IS11MW010900	5/5	244 - 439
Vanadium	1.1 J	2.6 J	µg/L	IS11MW050900	2/5	0.76 - 1.4
Zinc	34.5 J	181	µg/L	IS11MW020900	3/5	0.6 - 1.2

TABLE 1-8

Frequency of Detections in Area B Shallow Groundwater
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier		Maximum [1] Concentration Qualifier		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
VOCs								
1,1,1-Trichloroethane	15		15		µg/L	IS11MW070302	1/3	10 - 10
1,1-Dichloroethene	9	J	9	J	µg/L	IS11MW070302	1/3	10 - 10
Acetone	10		11		µg/L	IS11MW060302P	4/3	10 - 10
Benzene	1	J	1	J	µg/L	IS11MW060302 IS11MW060302P	1/3	10 - 10
Bromomethane	2	J	2	J	µg/L	IS11MW060302P	1/3	10 - 10
Chloromethane	2	J	2	J	µg/L	IS11MW060302 IS11MW080302	3/3	10 - 10
Cyclohexane	0.6	J	0.6	J	µg/L	IS11MW060302P	1/3	10 - 10
Ethylbenzene	0.4	J	0.4	J	µg/L	IS11MW060302P	1/3	10 - 10
Toluene	0.4	J	3	J	µg/L	IS11MW060302 IS11MW060302P	3/3	10 - 10
4-Methylphenol	0.8	J	5	J	µg/L	IS11MW070302	4/3	10 - 10
Acenaphthene	0.4	J	0.4	J	µg/L	IS11MW060302 IS11MW060302P	1/3	10 - 10
Acetophenone	0.4	J	0.4	J	µg/L	IS11MW060302P	1/3	10 - 10
Total Metals								
Aluminum	192	J	1,350		µg/L	IS11MW080302	4/3	200 - 200
Antimony	1.8	J	2.9		µg/L	IS11MW070302	2/3	60 - 60
Arsenic	2.9	J	2.9		µg/L	IS11MW060302	1/3	10 - 10
Barium	151	J	178		µg/L	IS11MW070302	3/3	200 - 200
Beryllium	0.51	J	0.64		µg/L	IS11MW060302	4/3	5 - 5
Calcium	51,200	J	54,100		µg/L	IS11MW070302	3/3	5000 - 5000
Chromium	1.6	J	7.9		µg/L	IS11MW060302	3/3	10 - 10
Copper	2.6	J	7.3	J	µg/L	IS11MW060302	3/3	25 - 25
Iron	31,300	J	44,700	J	µg/L	IS11MW080302	4/3	100 - 100
Lead	1.9	J	32.8		µg/L	IS11MW080302	4/3	3 - 3
Magnesium	14,700		27,000		µg/L	IS11MW070302	4/3	5000 - 5000
Manganese	1,450		3,020		µg/L	IS11MW080302	4/3	15 - 15
Nickel	2.3		6.4		µg/L	IS11MW060302	3/3	40 - 40
Potassium	4,220		6,300	J	µg/L	IS11MW080302	3/3	5000 - 5000
Selenium	2.5		2.9	J	µg/L	IS11MW070302	2/3	5 - 5
Silver	0.68	J	0.68	J	µg/L	IS11MW080302	1/3	10 - 10
Sodium	44,400	J	71,100	J	µg/L	IS11MW060302	3/3	5000 - 5000
Vanadium	2.1	J	3.6	J	µg/L	IS11MW080302	4/3	50 - 50
Zinc	15.7	J	39.9	J	µg/L	IS11MW080302	3/3	20 - 20
Dissolved Metals								
Antimony	2.8	J	2.8	J	µg/L	IS11MW070302	1/3	60 - 60
Arsenic	3.3	J	3.3	J	µg/L	IS11MW060302P	1/3	10 - 10
Barium	133	J	180	J	µg/L	IS11MW070302	4/3	200 - 200
Beryllium	0.49	J	0.77	J	µg/L	IS11MW080302	4/3	5 - 5
Calcium	47,500		54,600		µg/L	IS11MW070302	4/3	5000 - 5000
Chromium	1.5	J	7.7	J	µg/L	IS11MW060302	4/3	10 - 10
Iron	33,100		43,600		µg/L	IS11MW080302	3/3	100 - 100
Magnesium	14,700		27,800		µg/L	IS11MW070302	3/3	5000 - 5000
Manganese	1,330		3,010		µg/L	IS11MW080302	3/3	15 - 15
Nickel	1.4	J	3.9	J	µg/L	IS11MW060302 IS11MW060302P	4/3	40 - 40
Potassium	4,080	J	6,300	J	µg/L	IS11MW080302	4/3	5000 - 5000
Selenium	2.8	L	3.1	L	µg/L	IS11MW080302	2/3	5 - 5
Sodium	42,500		67,900		µg/L	IS11MW060302P	3/3	5000 - 5000

TABLE 1-8

Frequency of Detections in Area B Shallow Groundwater
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits
Thallium	3.8 J	6.2 J	µg/L	IS11MW070302	2/3	10 - 10
Vanadium	1.9 J	1.9 J	µg/L	IS11MW070302	1/3	50 - 50
Zinc	12.3 J	20.7	µg/L	IS11MW070302	3/3	20 - 20
TPH						
TPH-diesel range	500 J	500 J	µg/L	IS11MW060302P	1/3	1000 - 1100

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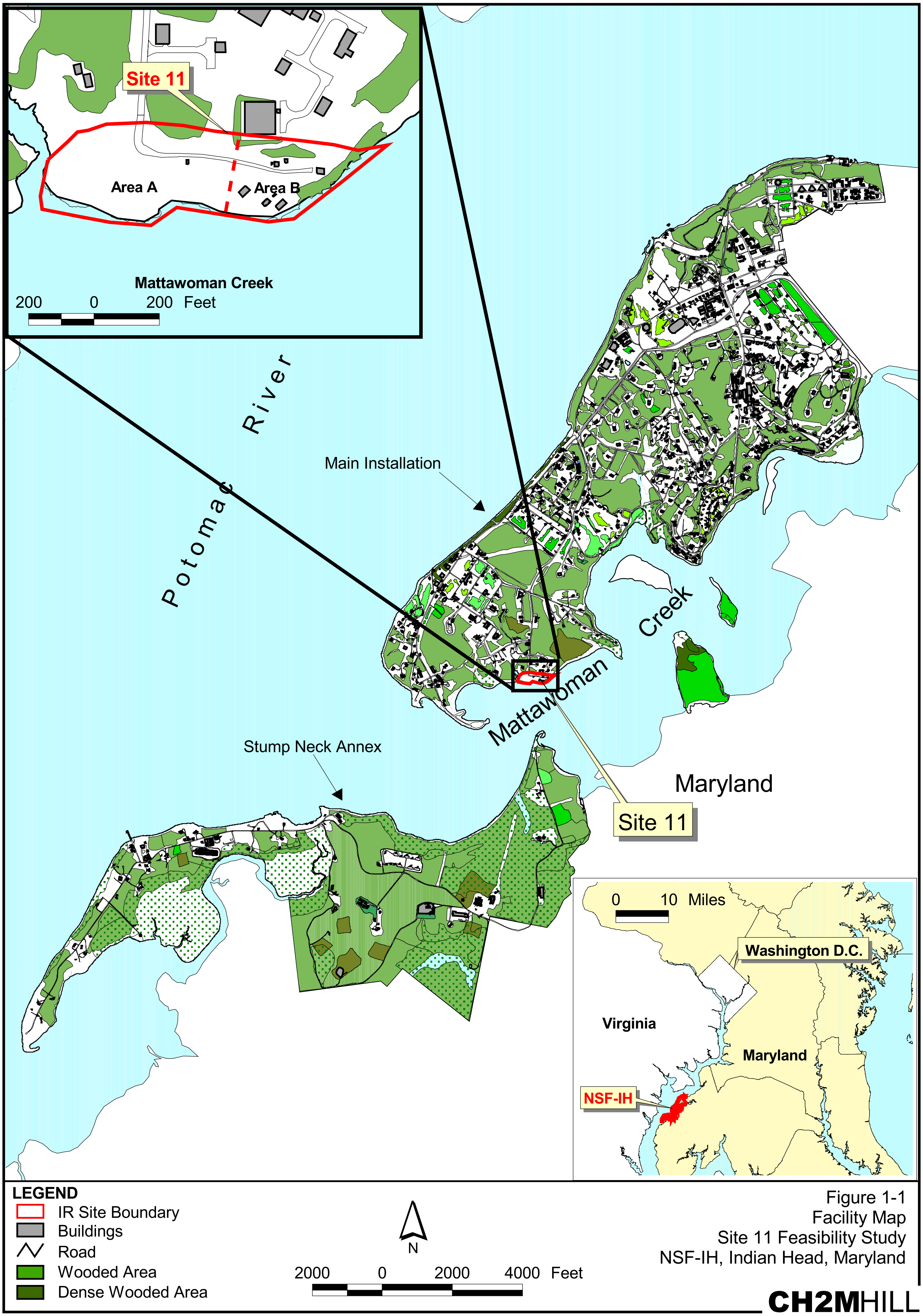

Figure 1-1
Facility Map
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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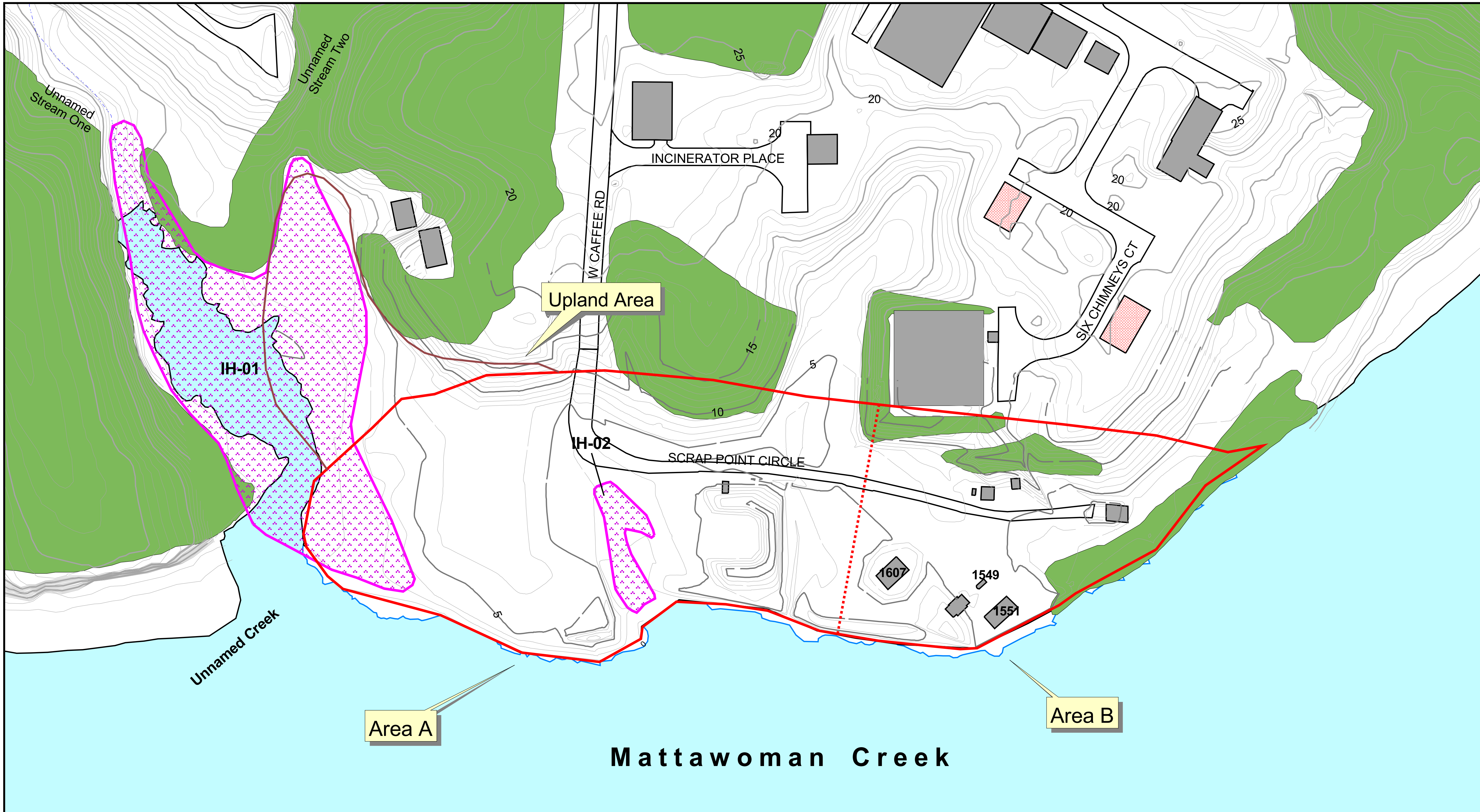

LEGEND
- Approximate Site Boundary
- Stream
- Buildings
- Demolished Buildings
- Wooded Area
- Roads
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- Approximate extent of the Upland Area based on the Extent of Solid Wasted determined in the Final RI
- Site 11 Area Divide
- Wetland Area

N

0 100 200 Feet

CH2M HILL, Inc. performed a Wetland Delineation of Site 11 on Feruary 10, 2005
utilizing a Global Positioning System to record and locate wetland flags, data points and existing features.

Figure 1-2
Site Layout
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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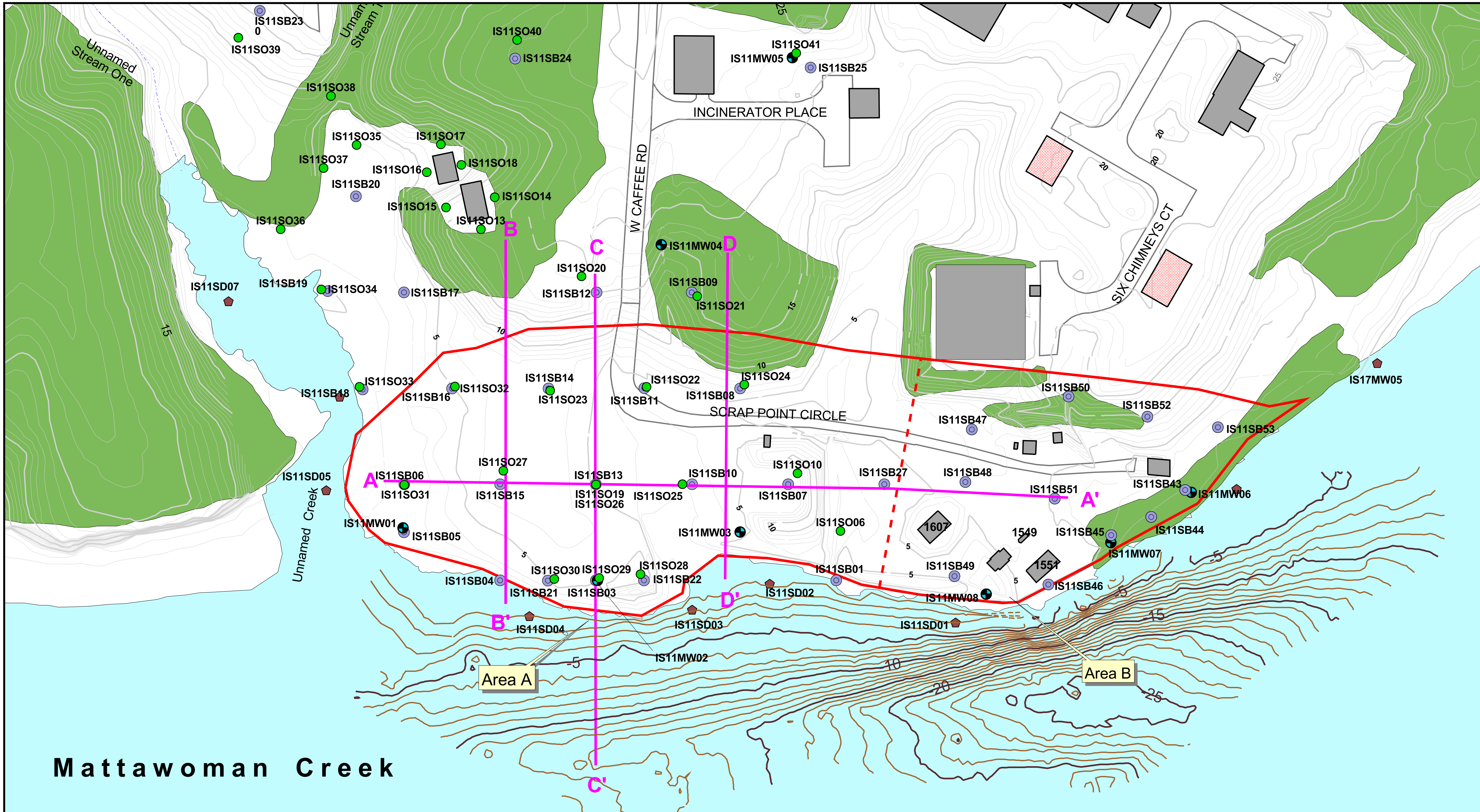

LEGEND

- Monitoring Well Location
- Surface Soil Location
- Soil Boring Location
- Sediment Sample Location
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Cross Section Location
- Roads
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- 1 foot Interval Bathymetry Line
- 5 foot Interval Bathymetry Line
- Wooded Area

Elevation contours between -4 feet and mean sea level interpolated between bathymetric survey and shoreline data.

N

100 0 100 Feet

1" = 100'

Figure 1-3
Locations of RI Sampling Points and Geologic Cross Sections
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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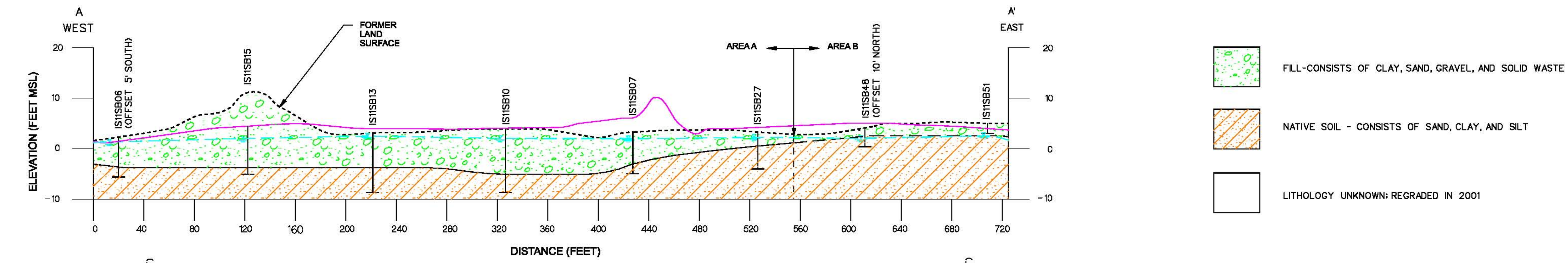
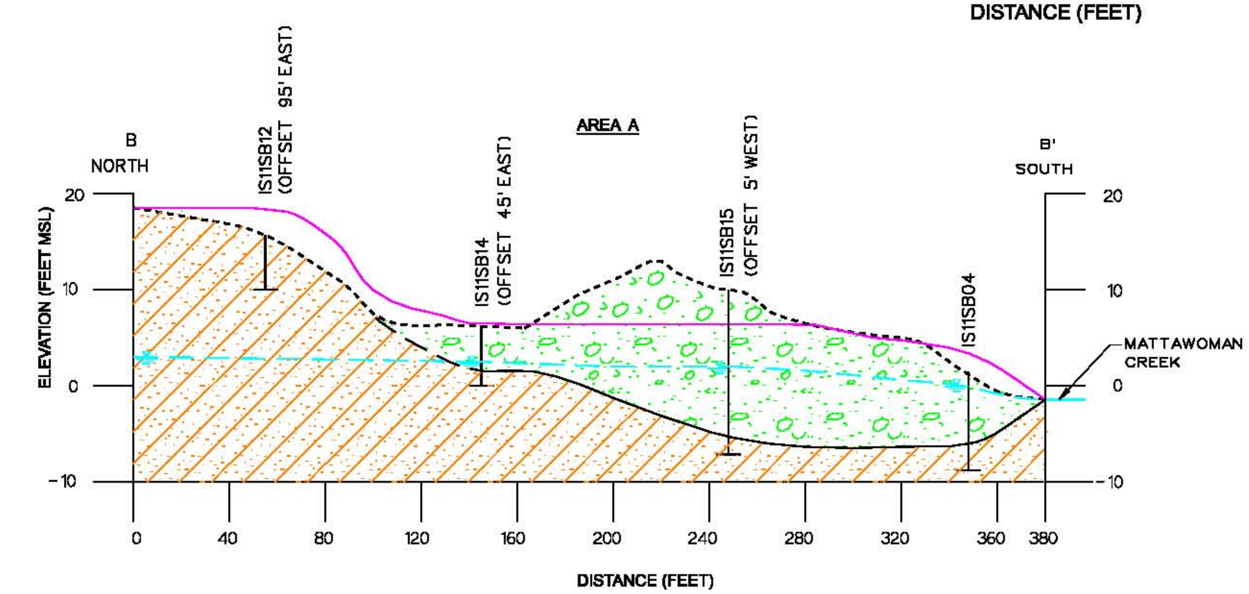
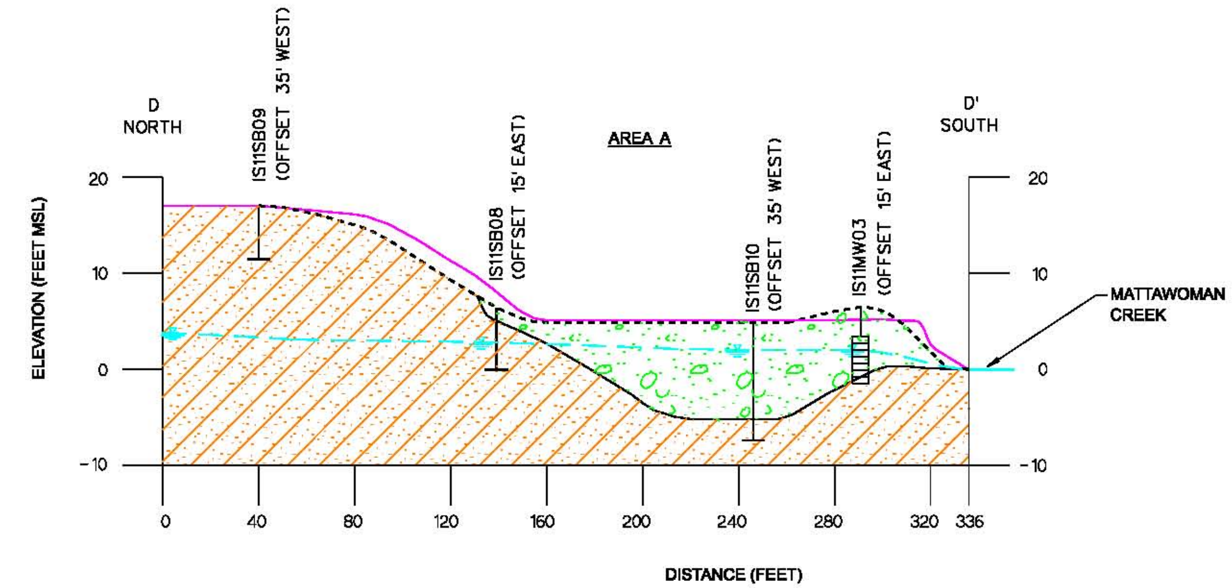
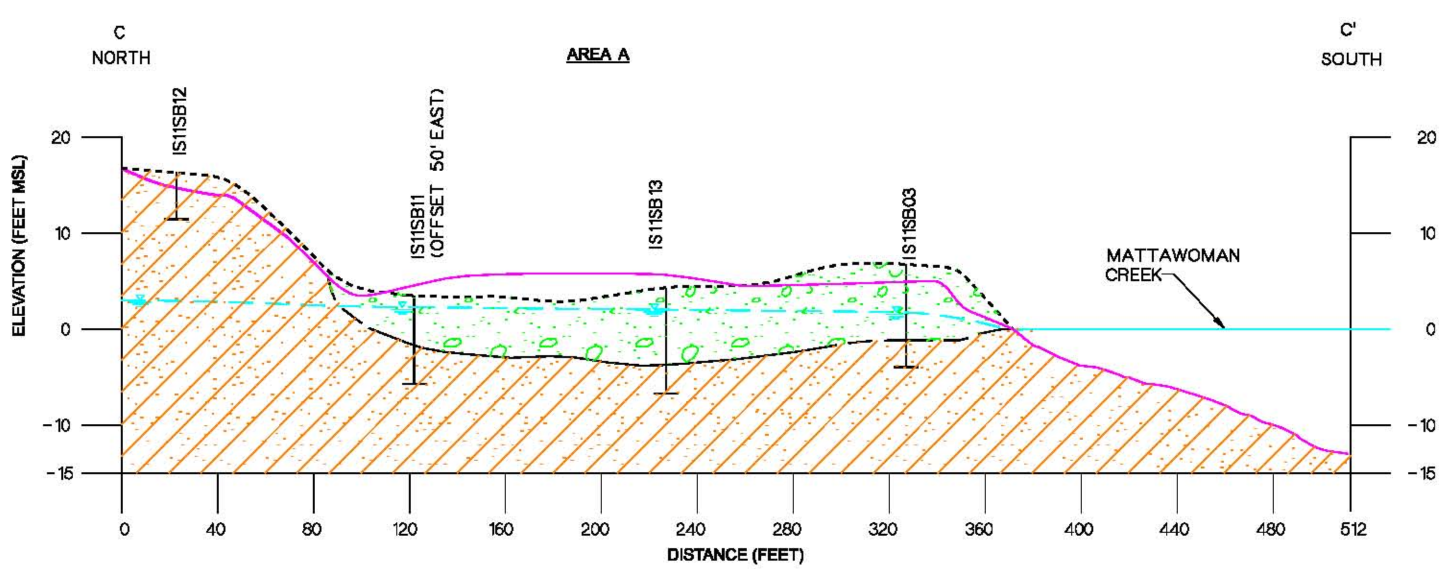
section_abcd1.dgn









NOTE:

1. MONITORING WELLS WERE SURVEYED BY BALDWIN AND GREGG IN DECEMBER 2000.
2. SOIL BORING LOCATIONS WERE SURVEYED WITH A GPS UNIT BY CH2M HILL; AREA A BORINGS IN 2000 AND AREA B BORINGS IN 2002
3. TOPOGRAPHIC BASE FEATURE TAKEN FROM MICRO STATION FILES SUPPLIED BY PATTON HARRIS RUST & ASSOC.,PC DATED JULY 26, 2005
4. SECTION PROFILE REPRESENTS SLOPE CONDITION AT CROSS SECTION A-A', B-B', C-C', D-D'. SEE FIGURE 1-3 FOR LOCATION OF ALL CROSS SECTIONS.
5. LOCATION OF SUBSURFACE STRATUM BOUNDARIES HAVE BEEN INTERPOLATED FROM INFORMATION OBTAINED AT LOCATION OF BORINGS. ACTUAL CONDITION BETWEEN BORINGS MAY BE DIFFERENT THAN SHOWN ON THE CROSS SECTION. SEE APPENDIX A IN THE RI (CH2M HILL, 2004) FOR LOGS.
6. HORIZONTAL DATUM MARYLAND STATE PLANE NAD 83 AND VERTICAL DATUM NAVD 88
7. SOLID WASTE CONSISTS OF BRICK, CONCRETE, TIRE, METAL DEBRIS, SLAG, UNDIFFERENTIATED RUBBLE & DEBRIS, TREATED WOOD AND WOOD PIECES. DESCRIPTION OF THE SOLID WASTE IS TAKEN FROM THE BORING LOGS.
8. INFERRED GROUNDWATER ELEVATION BASED ON WATER LEVELS MEASURED IN MARCH 2002 POTENTIOMETRIC SURFACE ELEVATION CONTOURS (FIGURE 1-7 IN THE FS REPORT).

10 FEET
40 FEET

HORIZONTAL: 1" = 40'
VERTICAL: 1" = 10'

LEGEND

- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- EXISTING GRADE BASED ON TOPOGRAPHIC SURVEY BY PATTON HARRIS RUST & ASSOC. IN 2005
- GRADE DURING 2000 RI, PRIOR TO 2001 REGRADING
- IS11SB14 — SAMPLE POINT (WITH PROJECTED DISTANCE, IF ANY)
- SOIL BORING OR MONITORING WELL
- INFERRED GROUNDWATER LEVEL (ELEVATION IN FEET-NAVD 88)
- MONITORING WELL SCREENED INTERNAL
- EOB (28.5) — EOB OF BORING (ELEVATION IN FEET-NAVD 88)

Figure 1-4
GEOLOGIC CROSS SECTIONS
SITE 11 FEASIBILITY STUDY
NSF-IH, INDIAN HEAD, MARYLAND

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Figure 1-5
RI Estimated Solid Waste Extent and Thickness
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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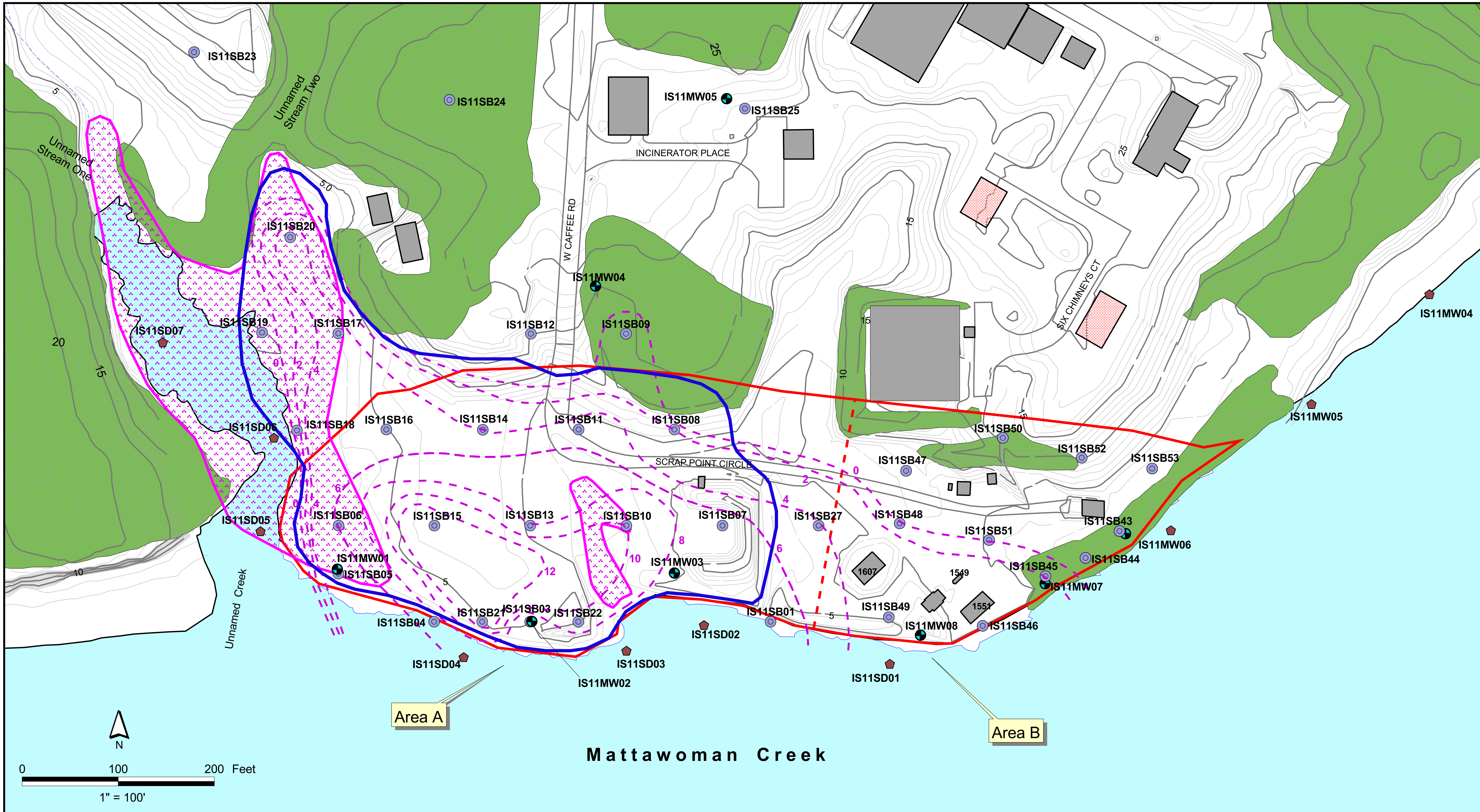

LEGEND

- Monitoring Well Location
- Soil Boring Location
- Sediment Sample Location
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Extent of Solid Waste Requiring Remediation (Based on the Final RI)
- Contour of Equal Fill Thickness (feet)
- Roads
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- Wetland Areas
- Wooded Area

Notes:
Fill depth based on native/fill contact called out in Boring Logs.
Solid waste determined by the presence of all material except wood, concrete, and brick.

Figure 1-6
Extent of Fill and Solid Waste Post 2001 Regrading
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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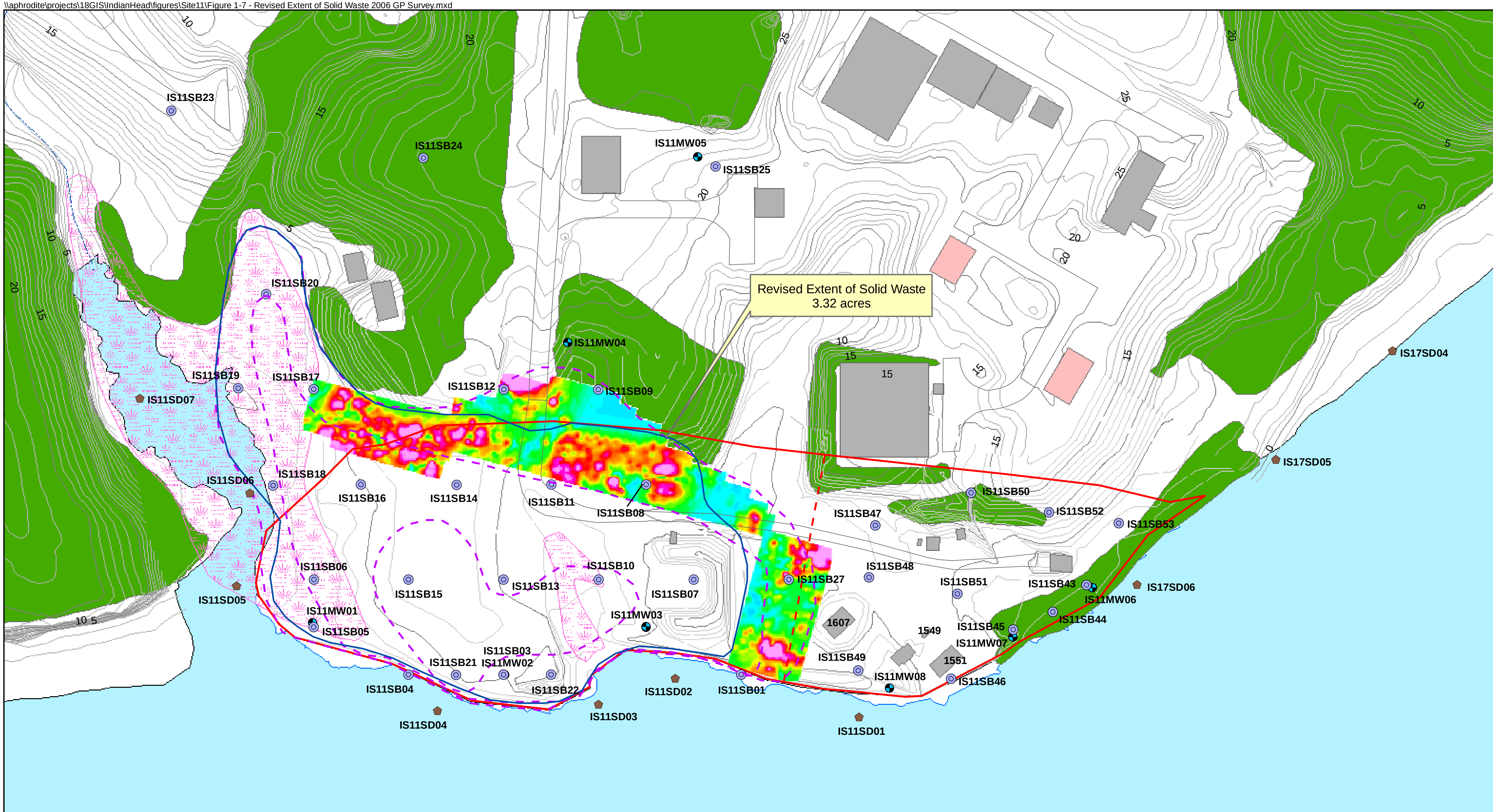
\\aphrodite\projects\18GIS\IndianHead\figures\Site11\Figure 1-7 - Revised Extent of Solid Waste 2006 GP Survey.mxd



Legend

- Monitoring Well Location
- Soil Boring Location
- Sediment Sample Location
- Approximate Site Boundary
- Building
- Demolished Building
- Wooded Area
- Wetlands Area
- Roads
- Revised Extent of Solid Waste Requiring Remediation (Based on 2006 Geophysical Survey)
- Extent of Solid Waste Requiring Remediation (Based on Final RI)
- Drainage Ditch
- Topographic Contours (5 foot intervals)
- Topographic Index Contours (1 foot interval)
- Geophysical Anamolies

Note:
Fill depth based on native/fill contact called out in Boring Logs.

N
W E
S

0 50 100
Feet

Figure 1-7
Revised Extent of Solid Waste Based on the
2006 Geophysical Survey
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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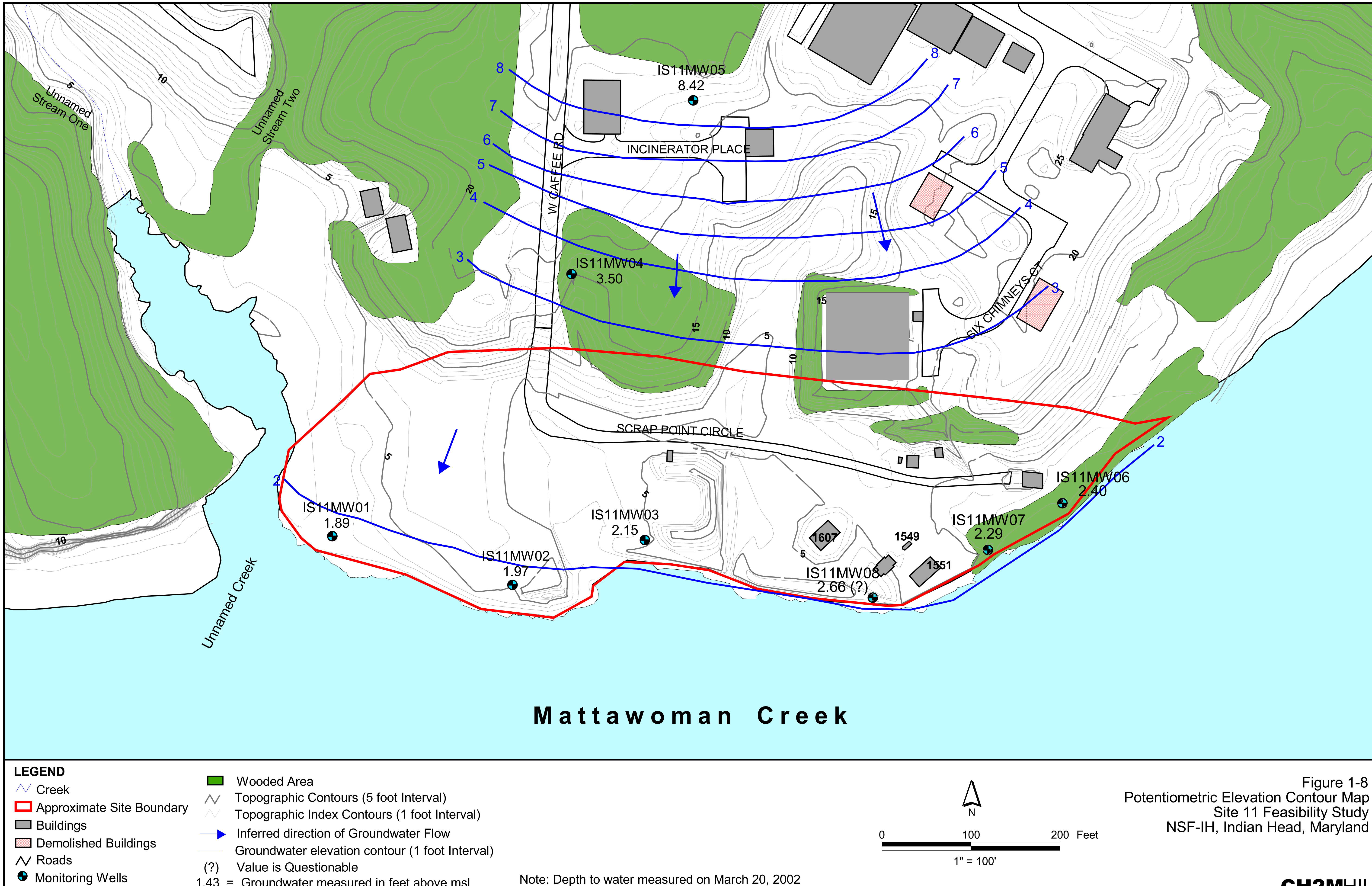

Figure 1-8
Potentiometric Elevation Contour Map
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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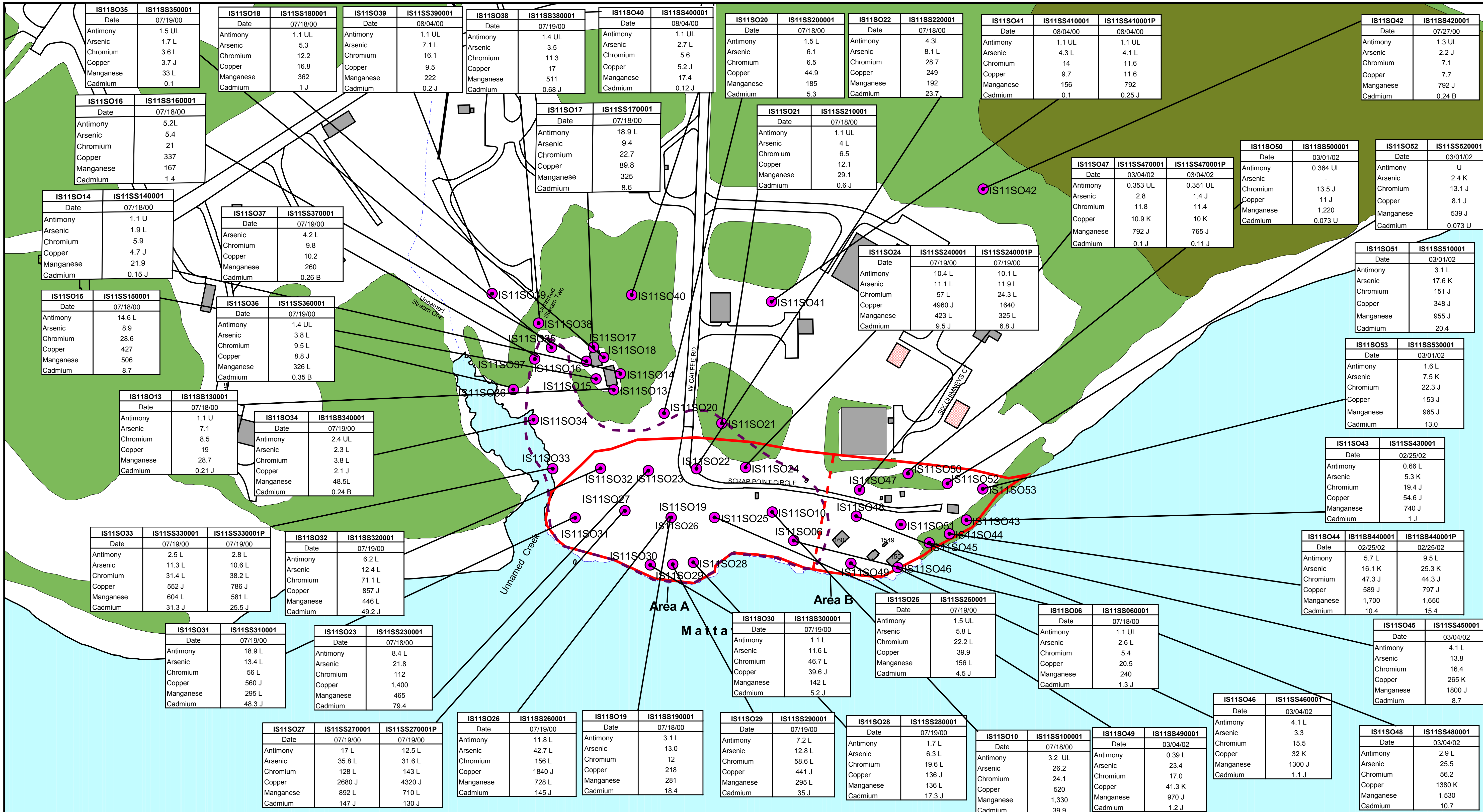

IS11SO35	IS11SS350001
Date	07/19/00
Antimony	1.5 UL
Arsenic	1.7 L
Chromium	3.6 L
Copper	3.7 J
Manganese	33 L
Cadmium	0.1

IS11SO18	IS11SS180001
Date	07/18/00
Antimony	1.1 UL
Arsenic	5.3
Chromium	12.2
Copper	16.8
Manganese	362
Cadmium	1 J

IS11SO39	IS11SS390001
Date	08/04/00
Antimony	1.1 UL
Arsenic	7.1 L
Chromium	16.1
Copper	9.5
Manganese	222
Cadmium	0.2 J

IS11SO38	IS11SS380001
Date	07/19/00
Antimony	1.4 UL
Arsenic	3.5
Chromium	11.3
Copper	17
Manganese	511
Cadmium	0.68 J

IS11SO40	IS11SS400001
Date	08/04/00
Antimony	1.1 UL
Arsenic	2.7 L
Chromium	5.6
Copper	5.2 J
Manganese	17.4
Cadmium	0.12 J

IS11SO20	IS11SS200001
Date	07/18/00
Antimony	1.5 L
Arsenic	6.1
Chromium	6.5
Copper	44.9
Manganese	185
Cadmium	5.3

IS11SO22	IS11SS220001
Date	07/18/00
Antimony	4.3L
Arsenic	8.1 L
Chromium	28.7
Copper	249
Manganese	192
Cadmium	23.7

IS11SO41	IS11SS410001	IS11SS410001P
Date	08/04/00	08/04/00
Antimony	1.1 UL	1.1 UL
Arsenic	4.3 L	4.1 L
Chromium	14	11.6
Copper	9.7	11.6
Manganese	156	792
Cadmium	0.1	0.25 J

IS11SO42	IS11SS420001
Date	07/27/00
Antimony	1.3 UL
Arsenic	2.2 J
Chromium	7.1
Copper	7.7
Manganese	792 J
Cadmium	0.24 B

IS11SO16	IS11SS160001
Date	07/18/00
Antimony	5.2L
Arsenic	5.4
Chromium	21
Copper	337
Manganese	167
Cadmium	1.4

IS11SO17	IS11SS170001
Date	07/18/00
Antimony	18.9 L
Arsenic	9.4
Chromium	22.7
Copper	89.8
Manganese	325
Cadmium	8.6

IS11SO21	IS11SS210001
Date	07/18/00
Antimony	1.1 UL
Arsenic	4 L
Chromium	6.5
Copper	12.1
Manganese	29.1
Cadmium	0.6 J

IS11SO50	IS11SS500001
Date	03/01/02
Antimony	0.364 UL
Arsenic	-
Chromium	13.5 J
Copper	11 J
Manganese	1,220
Cadmium	0.073 U

IS11SO52	IS11SS520001
Date	03/01/02
Antimony	U
Arsenic	2.4 K
Chromium	13.1 J
Copper	8.1 J
Manganese	539 J
Cadmium	0.073 U

IS11SO47	IS11SS470001	IS11SS470001P
Date	03/04/02	03/04/02
Antimony	0.353 UL	0.351 UL
Arsenic	2.8	1.4 J
Chromium	11.8	11.4
Copper	10.9 K	10 K
Manganese	792 J	765 J
Cadmium	0.1 J	0.11 J

IS11SO14	IS11SS140001
Date	07/18/00
Antimony	1.1 U
Arsenic	1.9 L
Chromium	5.9
Copper	4.7 J
Manganese	21.9
Cadmium	0.15 J

IS11SO37	IS11SS370001
Date	07/19/00
Arsenic	4.2 L
Chromium	9.8
Copper	10.2
Manganese	260
Cadmium	0.26 B

IS11SO24	IS11SS240001	IS11SS240001P
Date	07/19/00	07/19/00
Antimony	10.4 L	10.1 L
Arsenic	11.1 L	11.9 L
Chromium	57 L	24.3 L
Copper	4960 J	1640
Manganese	423 L	325 L
Cadmium	9.5 J	6.8 J

IS11SO51	IS11SS510001
Date	03/01/02
Antimony	3.1 L
Arsenic	17.6 K
Chromium	151 J
Copper	348 J
Manganese	955 J
Cadmium	20.4

IS11SO15	IS11SS150001
Date	07/18/00
Antimony	14.6 L
Arsenic	8.9
Chromium	28.6
Copper	427
Manganese	506
Cadmium	8.7

IS11SO36	IS11SS360001
Date	07/19/00
Antimony	1.4 UL
Arsenic	3.8 L
Chromium	9.5 L
Copper	8.8 J
Manganese	326 L
Cadmium	0.35 B

IS11SO53	IS11SS530001
Date	03/01/02
Antimony	1.6 L
Arsenic	7.5 K
Chromium	22.3 J
Copper	153 J
Manganese	965 J
Cadmium	13.0

IS11SO13	IS11SS130001
Date	07/18/00
Antimony	1.1 U
Arsenic	7.1
Chromium	8.5
Copper	19
Manganese	28.7
Cadmium	0.21 J

IS11SO34	IS11SS340001
Date	07/19/00
Antimony	2.4 UL
Arsenic	2.3 L
Chromium	3.8 L
Copper	2.1 J
Manganese	48.5L
Cadmium	0.24 B

IS11SO43	IS11SS430001
Date	02/25/02
Antimony	0.66 L
Arsenic	5.3 K
Chromium	19.4 J
Copper	54.6 J
Manganese	740 J
Cadmium	1 J

IS11SO33	IS11SS330001	IS11SS330001P
Date	07/19/00	07/19/00
Antimony	2.5 L	2.8 L
Arsenic	11.3 L	10.6 L
Chromium	31.4 L	38.2 L
Copper	552 J	786 J
Manganese	604 L	581 L
Cadmium	31.3 J	25.5 J

IS11SO32	IS11SS320001
Date	07/19/00
Antimony	6.2 L
Arsenic	12.4 L
Chromium	71.1 L
Copper	857 J
Manganese	446 L
Cadmium	49.2 J

IS11SO44	IS11SS440001	IS11SS440001P
Date	02/25/02	02/25/02
Antimony	5.7 L	9.5 L
Arsenic	16.1 K	25.3 K
Chromium	47.3 J	44.3 J
Copper	589 J	797 J
Manganese	1,700	1,650
Cadmium	10.4	15.4

IS11SO25	IS11SS250001
Date	07/19/00
Antimony	1.5 UL
Arsenic	5.8 L
Chromium	22.2 L
Copper	39.9
Manganese	156 L
Cadmium	4.5 J

IS11SO06	IS11SS060001
Date	07/18/00
Antimony	1.1 UL
Arsenic	2.6 L
Chromium	5.4
Copper	20.5
Manganese	240
Cadmium	1.3 J

IS11SO30	IS11SS300001
Date	07/19/00
Antimony	1.1 L
Arsenic	11.6 L
Chromium	46.7 L
Copper	39.6 J
Manganese	142 L
Cadmium	5.2 J

IS11SO45	IS11SS450001
Date	03/04/02
Antimony	4.1 L
Arsenic	13.8
Chromium	16.4
Copper	265 K
Manganese	1800 J
Cadmium	8.7

IS11SO31	IS11SS310001
Date	07/19/00
Antimony	18.9 L
Arsenic	13.4 L
Chromium	56 L
Copper	560 J
Manganese	295 L
Cadmium	48.3 J

IS11SO23	IS11SS230001
Date	07/18/00
Antimony	8.4 L
Arsenic	21.8
Chromium	112
Copper	1,400
Manganese	465
Cadmium	79.4

IS11SO46	IS11SS460001
Date	03/04/02
Antimony	4.1 L
Arsenic	3.3
Chromium	15.5
Copper	32 K
Manganese	1300 J
Cadmium	1.1 J

IS11SO27	IS11SS270001	IS11SS270001P
Date	07/19/00	07/19/00
Antimony	17 L	12.5 L
Arsenic	35.8 L	31.6 L
Chromium	128 L	143 L
Copper	2680 J	4320 J
Manganese	892 L	710 L
Cadmium	147 J	130 J

IS11SO26	IS11SS260001
Date	07/19/00
Antimony	11.8 L
Arsenic	42.7 L
Chromium	156 L
Copper	1840 J
Manganese	728 L
Cadmium	145 J

IS11SO19	IS11SS190001
Date	07/18/00
Antimony	3.1 L
Arsenic	13.0
Chromium	12
Copper	218
Manganese	281
Cadmium	18.4

IS11SO29	IS11SS290001
Date	07/19/00
Antimony	7.2 L
Arsenic	12.8 L
Chromium	58.6 L
Copper	441 J
Manganese	295 L
Cadmium	35 J

IS11SO28	IS11SS280001
Date	07/19/00
Antimony	1.7 L
Arsenic	6.3 L
Chromium	19.6 L
Copper	136 J
Manganese	136 L
Cadmium	17.3 J

IS11SO10	IS11SS100001
Date	07/18/00
Antimony	3.2 UL
Arsenic	26.2
Chromium	24.1
Copper	520
Manganese	1,330
Cadmium	39.9

IS11SO49	IS11SS490001
Date	03/04/02
Antimony	0.39 L
Arsenic	23.4
Chromium	17.0
Copper	41.3 K
Manganese	970 J
Cadmium	1.2 J

IS11SO48	IS11SS480001
Date	03/04/02
Antimony	2.9 L
Arsenic	25.5
Chromium	56.2
Copper	1380 K
Manganese	1,530
Cadmium	10.7

LEGEND

- Surface Soil Samples
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Road
- Wooded Area
- Dense Wooded Area

K = Biased High
L = Biased Low
U = Not detected
UL = Not detected, quantitation limit is probably higher
J = Estimated Value Below the Detection Limit
B = Not detected substantially above the level reported in laboratory or field blanks

- Contour of Equal Waste Thickness (feet)
- Boundary Between Area A and Area B
-- Area A Sampled July 20, 2000 - August 9, 2000
-- Area B Sampled February 25, 2002 - March 26, 2002

All concentrations are in mg/kg (Milligrams per kilogram)

N

0 200 400 Feet

1 in = 200 ft

Figure 1-9
Detections of Select Metals in Surface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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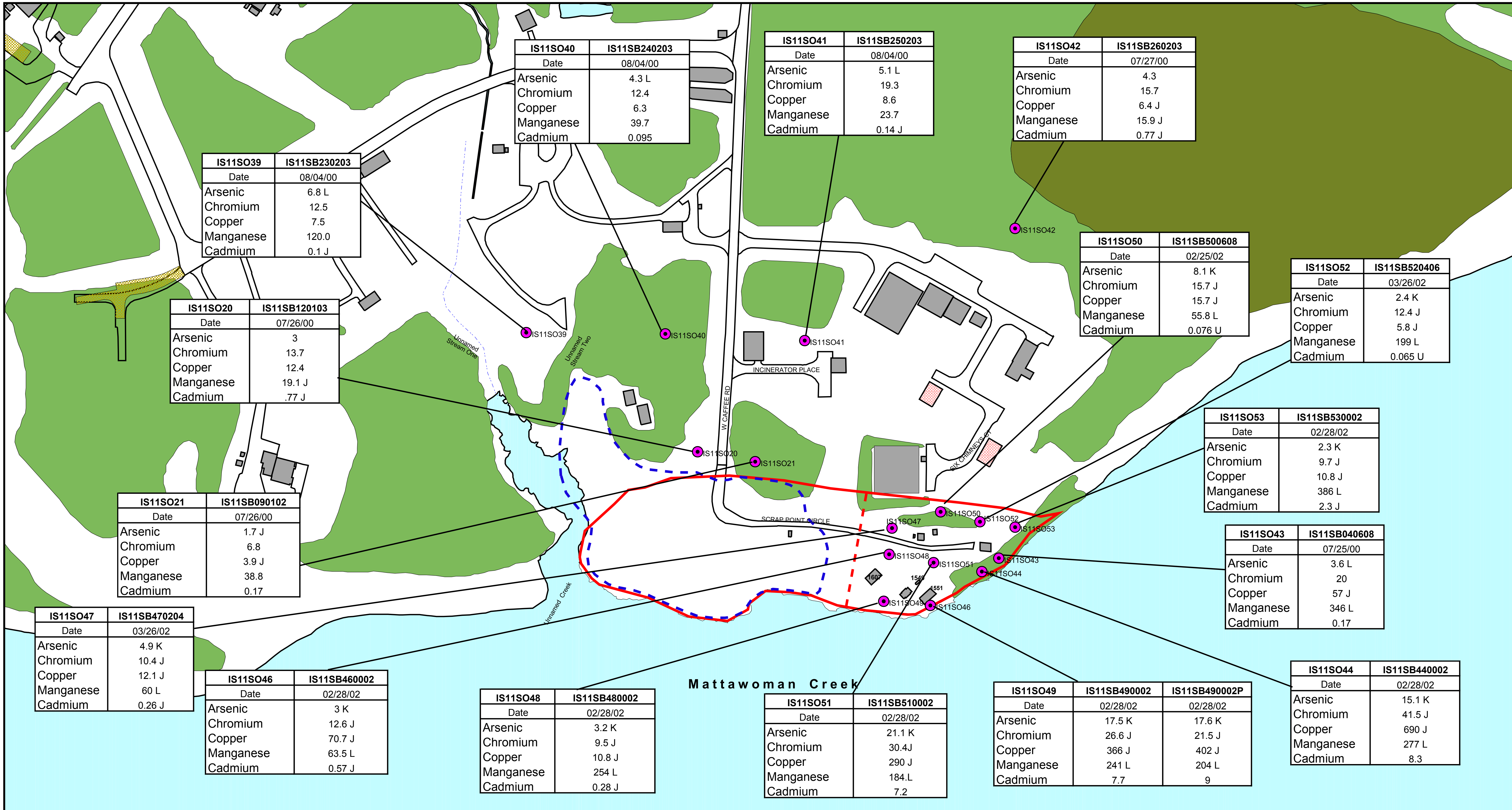

IS11SO40	IS11SB240203
Date	08/04/00
Arsenic	4.3 L
Chromium	12.4
Copper	6.3
Manganese	39.7
Cadmium	0.095

IS11SO41	IS11SB250203
Date	08/04/00
Arsenic	5.1 L
Chromium	19.3
Copper	8.6
Manganese	23.7
Cadmium	0.14 J

IS11SO42	IS11SB260203
Date	07/27/00
Arsenic	4.3
Chromium	15.7
Copper	6.4 J
Manganese	15.9 J
Cadmium	0.77 J

IS11SO39	IS11SB230203
Date	08/04/00
Arsenic	6.8 L
Chromium	12.5
Copper	7.5
Manganese	120.0
Cadmium	0.1 J

IS11SO50	IS11SB500608
Date	02/25/02
Arsenic	8.1 K
Chromium	15.7 J
Copper	15.7 J
Manganese	55.8 L
Cadmium	0.076 U

IS11SO52	IS11SB520406
Date	03/26/02
Arsenic	2.4 K
Chromium	12.4 J
Copper	5.8 J
Manganese	199 L
Cadmium	0.065 U

IS11SO20	IS11SB120103
Date	07/26/00
Arsenic	3
Chromium	13.7
Copper	12.4
Manganese	19.1 J
Cadmium	.77 J

IS11SO53	IS11SB530002
Date	02/28/02
Arsenic	2.3 K
Chromium	9.7 J
Copper	10.8 J
Manganese	386 L
Cadmium	2.3 J

IS11SO21	IS11SB090102
Date	07/26/00
Arsenic	1.7 J
Chromium	6.8
Copper	3.9 J
Manganese	38.8
Cadmium	0.17

IS11SO43	IS11SB040608
Date	07/25/00
Arsenic	3.6 L
Chromium	20
Copper	57 J
Manganese	346 L
Cadmium	0.17

IS11SO47	IS11SB470204
Date	03/26/02
Arsenic	4.9 K
Chromium	10.4 J
Copper	12.1 J
Manganese	60 L
Cadmium	0.26 J

IS11SO46	IS11SB460002
Date	02/28/02
Arsenic	3 K
Chromium	12.6 J
Copper	70.7 J
Manganese	63.5 L
Cadmium	0.57 J

IS11SO48	IS11SB480002
Date	02/28/02
Arsenic	3.2 K
Chromium	9.5 J
Copper	10.8 J
Manganese	254 L
Cadmium	0.28 J

IS11SO51	IS11SB510002
Date	02/28/02
Arsenic	21.1 K
Chromium	30.4J
Copper	290 J
Manganese	184.L
Cadmium	7.2

IS11SO49	IS11SB490002	IS11SB490002P
Date	02/28/02	02/28/02
Arsenic	17.5 K	17.6 K
Chromium	26.6 J	21.5 J
Copper	366 J	402 J
Manganese	241 L	204 L
Cadmium	7.7	9

IS11SO44	IS11SB440002
Date	02/28/02
Arsenic	15.1 K
Chromium	41.5 J
Copper	690 J
Manganese	277 L
Cadmium	8.3

LEGEND

- Subsurface Soil Samples
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Road
- Wooded Area
- Contour of Equal Waste Thickness (feet)
- Boundary Between Area A and Area B
- Dense Wooded Area

L = Biased Low
J = Estimated Value Below the Detection Limit
K = Biased High
U = Not detected

-- Area A Sampled July 20, 2000 - August 9, 2000
-- Area B Sampled February 25, 2002 - March 26, 2002

All concentrations are in mg/kg (Milligrams per kilogram)

N

0 200 400 Feet

1 in = 200 ft

Figure 1-10
Detections of Select Metals in Subsurface Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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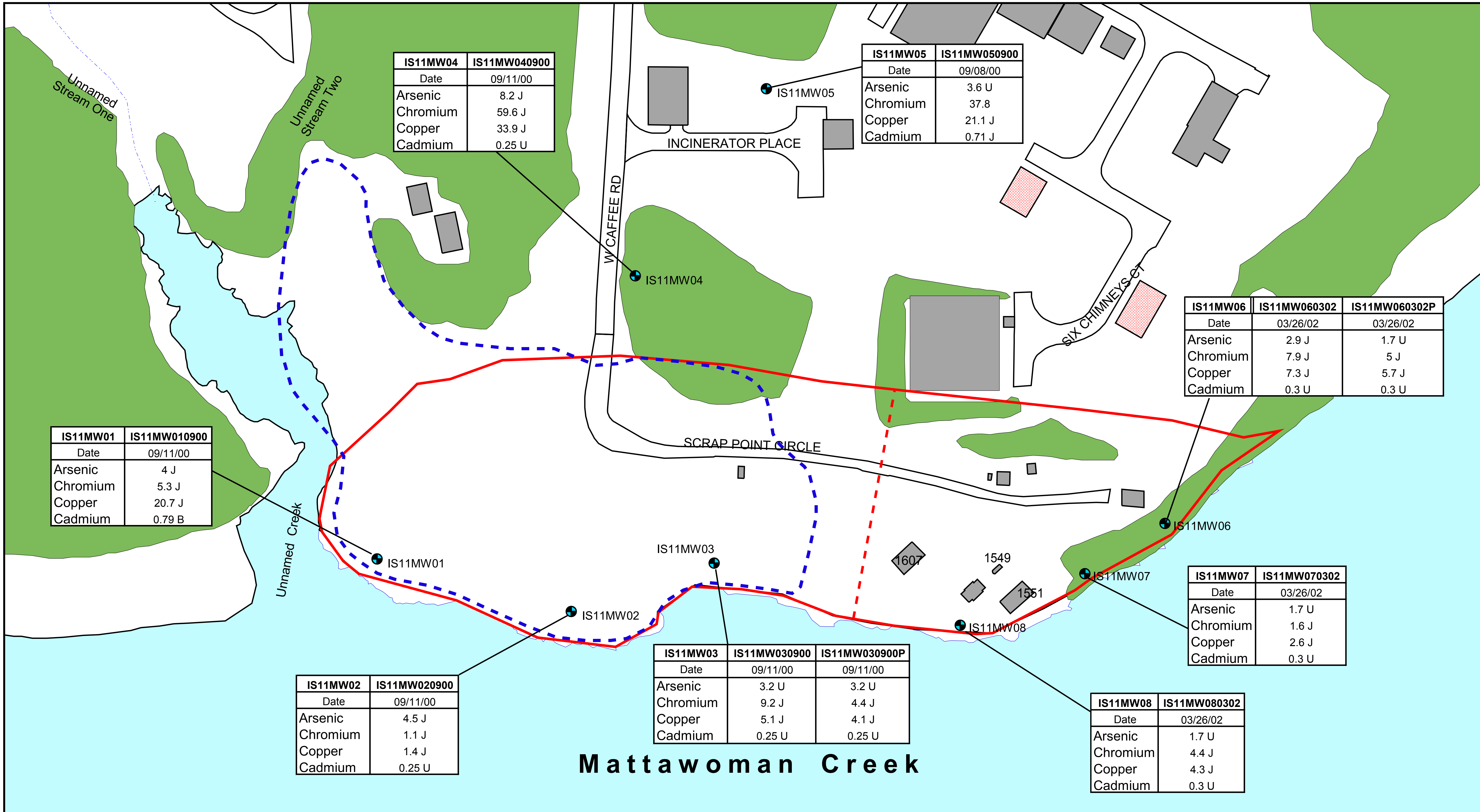

IS11MW01	IS11MW010900
Date	09/11/00
Arsenic	4 J
Chromium	5.3 J
Copper	20.7 J
Cadmium	0.79 B

IS11MW02	IS11MW020900
Date	09/11/00
Arsenic	4.5 J
Chromium	1.1 J
Copper	1.4 J
Cadmium	0.25 U

IS11MW03	IS11MW030900	IS11MW030900P
Date	09/11/00	09/11/00
Arsenic	3.2 U	3.2 U
Chromium	9.2 J	4.4 J
Copper	5.1 J	4.1 J
Cadmium	0.25 U	0.25 U

IS11MW04	IS11MW040900
Date	09/11/00
Arsenic	8.2 J
Chromium	59.6 J
Copper	33.9 J
Cadmium	0.25 U

IS11MW05	IS11MW050900
Date	09/08/00
Arsenic	3.6 U
Chromium	37.8
Copper	21.1 J
Cadmium	0.71 J

IS11MW06	IS11MW060302	IS11MW060302P
Date	03/26/02	03/26/02
Arsenic	2.9 J	1.7 U
Chromium	7.9 J	5 J
Copper	7.3 J	5.7 J
Cadmium	0.3 U	0.3 U

IS11MW07	IS11MW070302
Date	03/26/02
Arsenic	1.7 U
Chromium	1.6 J
Copper	2.6 J
Cadmium	0.3 U

IS11MW08	IS11MW080302
Date	03/26/02
Arsenic	1.7 U
Chromium	4.4 J
Copper	4.3 J
Cadmium	0.3 U

LEGEND

- Monitoring Wells
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Road
- Wooded Area
- Contour of Equal Waste Thickness (feet)
- Boundary Between Area A and Area B

U = Not detected
B = Not detected substantially above the level reported in laboratory or field blanks
J = Estimated value below the detection limit
All concentrations are in µg/l (Micrograms per liter)

-- Area A Sampled July 20, 2000 - August 9, 2000
-- Area B Sampled February 25, 2002 - March 26, 2002

N

0 100 200 Feet

1 in = 100 ft

Figure 1-11
Detections of Select Total and Dissolved Metals in Groundwater
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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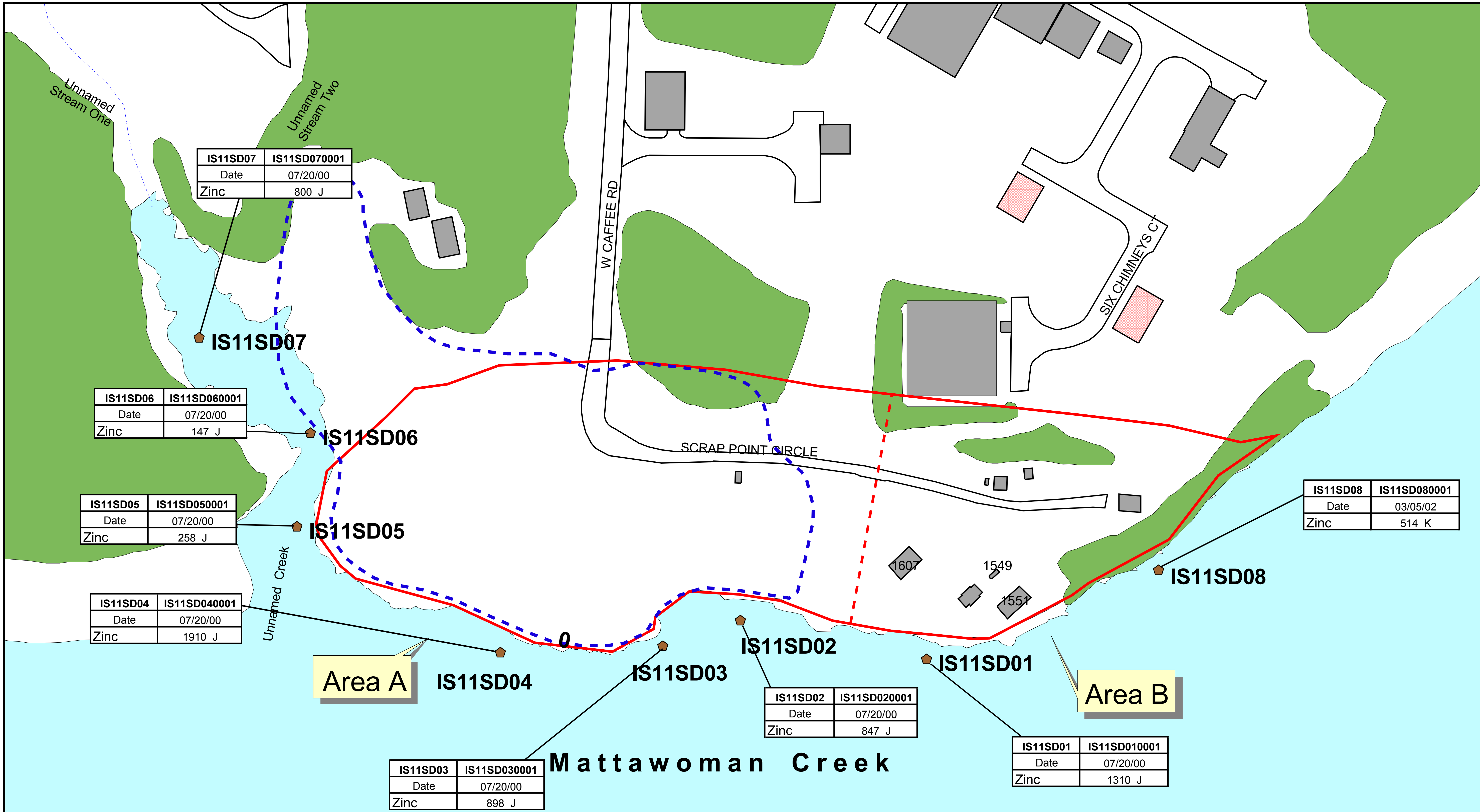

IS11SD07	IS11SD070001
Date	07/20/00
Zinc	800 J

IS11SD06	IS11SD060001
Date	07/20/00
Zinc	147 J

IS11SD05	IS11SD050001
Date	07/20/00
Zinc	258 J

IS11SD04	IS11SD040001
Date	07/20/00
Zinc	1910 J

IS11SD03	IS11SD030001
Date	07/20/00
Zinc	898 J

IS11SD02	IS11SD020001
Date	07/20/00
Zinc	847 J

IS11SD01	IS11SD010001
Date	07/20/00
Zinc	1310 J

IS11SD08	IS11SD080001
Date	03/05/02
Zinc	514 K

LEGEND

- Sediment Samples
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Road
- Wooded Area

Contour of Equal Waste Thickness (feet)
Boundary Between Area A and Area B
J = Estimated Value Below the Detection Limit
K = Biased High
-- Area A Sampled July 20, 2000 - August 9, 2000
-- Area B Sampled February 25, 2002 - March 26, 2002
All concentrations are in mg/kg (Milligrams per kilogram)

Figure 1-12
Detections of Zinc in Sediment
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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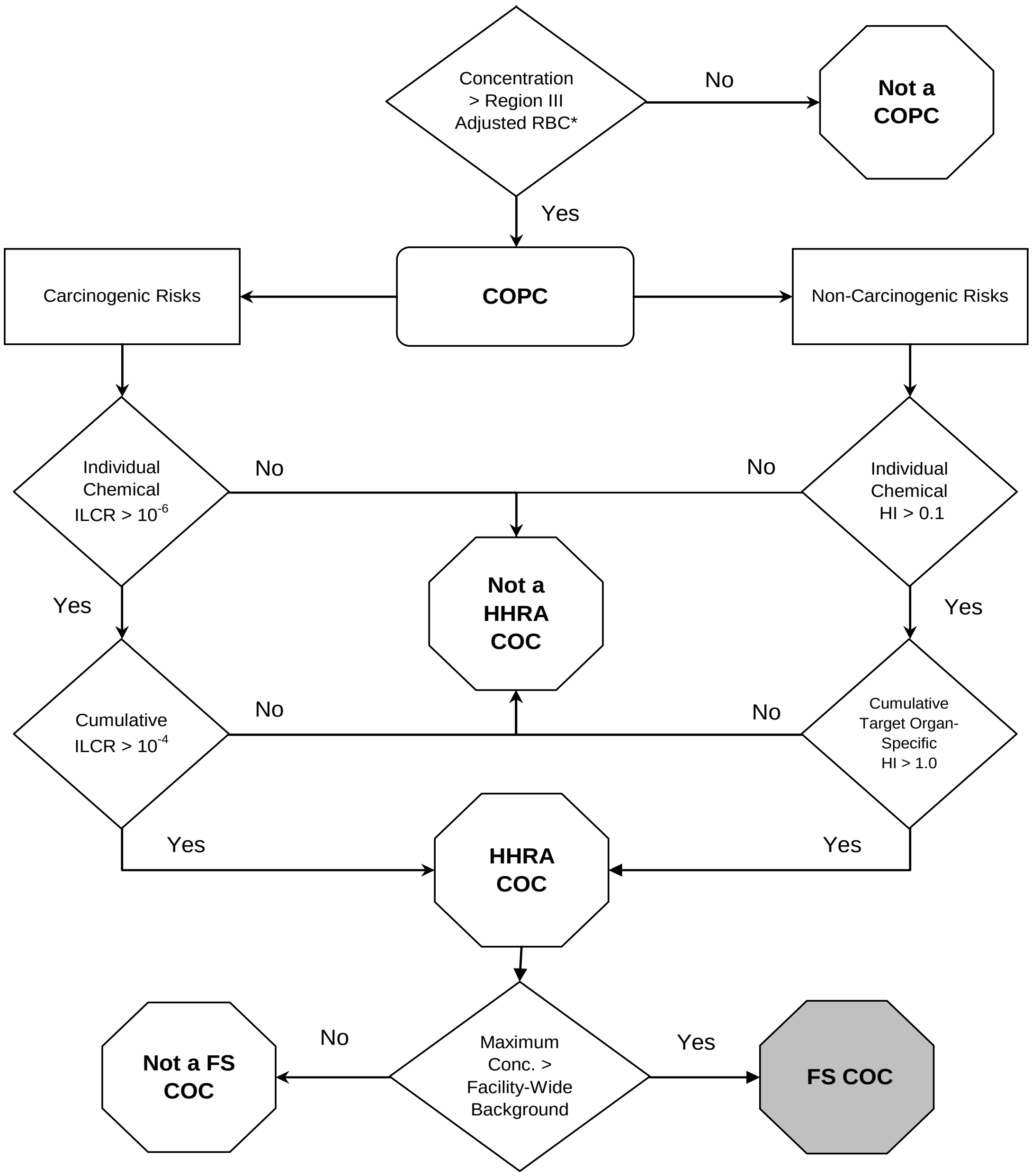

*Note: Adjusted RBCs means that RBCs based on noncarcinogenic endpoints are divided by ten so that the RBC is based on a target hazard index of one; RBCs based on carcinogenic endpoints are not adjusted and therefore are based on a target cancer risk of 1 in 1,000,000. For groundwater, the maximum detected concentration is compared to the adjusted tap water RBC. For soil, the maximum detected concentration is compared to the adjusted residential contact with soil RBC. For surface water, the maximum detected concentration is compared to 10 times the adjusted tap water RBC.

FIGURE 1-13
COC Selection Diagram
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

SECTION 2

RAOs, ARARs, SRGs, and AAs

This section presents general and site-specific RAOs and identifies corresponding ARARs for Site 11. The general RAOs are defined by the NCP (40 CFR 300.430 et seq.) and by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC §§ 9601 et seq.), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The NCP provides guidance and requirements for developing remedies.

CERCLA § 121(d) of SARA mandates that site remediation under CERCLA must achieve a level or standard of control for hazardous substances that at least attains such levels as specified in ARARs. Only promulgated federal and Maryland laws and regulations can be considered ARARs. In addition to ARARs, proposed rules, guidance documents, directives, and similar documents that might affect a CERCLA remedial action are "to-be-considered" (TBC) documents.

ARARs and the base-wide background concentrations of COCs in soil, sediment, and shallow groundwater determine the SRGs. SRGs then determine the areas of attainment (AAs), and subsequently area of remediation.

2.1 NCP and CERCLA Objectives

The NCP requires that the selected remedy meet the following objectives:

- Each remedial action selected shall be protective of human health and the environment (40 CFR 300.430 (f)(1)(ii)(A)).
- Onsite remedial actions that are selected must attain the ARARs identified at the time of the Record of Decision (ROD) signature (40 CFR 300.430(f)(1)(ii)(B)).
- Each remedial action selected shall be cost-effective, provided that it first satisfies the threshold criteria set forth in 40 CFR 300.430 (f)(1)(ii)(A) and (B). A remedy shall be cost-effective if its costs are proportional to its overall effectiveness (40 CFR 300.430 (f)(1)(ii)(D)).
- Each remedial action shall use permanent solutions and alternative treatment technologies or resource-recovery technology to the maximum extent practicable (40 CFR 300.430 (f)(1)(ii)(E)).

The statutory scope of CERCLA was amended by SARA to include the following general objectives for remedial action at all CERCLA sites:

- Remedial actions "…shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further releases at a minimum which assures protection of human health and the environment." (CERCLA Section 121(d))

- Remedial actions "…in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principal element" (CERCLA Section 121(b)) are preferred. If the treatment or recovery technologies selected are not a permanent solution, an explanation must be published.
- The least-favored remedial actions are those that include "off-site transport and disposal of hazardous substances or contaminated materials without treatment where practicable treatment technologies are available." (Section 121(b))
- The selected remedy must comply with or attain the level of any "standard, requirement, criteria, or limitation under any federal environmental law or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any federal standard, requirement, criteria, or limitation." (Section 121(d)(2)(A))

2.2 Media of Interest

Based on the findings and conclusions of the RI, the BERA, and reassessment of human health risks for Area B, the media of interest potentially requiring remediation at Site 11 are surface soil, subsurface soil, and solid waste, and nearshore sediment along the Mattawoman Creek adjacent to Site 11. As described in Section 1.7.1, the only unacceptable risks to human health identified in the Baseline HHRA and Area B HHRA were from exposure to soil and groundwater under the hypothetical future residential exposure scenario. The only unacceptable ecological risk was attributed to zinc in the nearshore sediment.

The COCs for groundwater for Site 11 were primarily based on the unacceptable human health risk based on the potable use of groundwater to the future residents. None of the groundwater final COCs exceed MCLs, which are the federal enforceable standards for drinking water. For constituents with no available MCLs, their concentrations are either less than or consistent with their respective background concentrations. Furthermore, their concentrations are either less than or consistent with the background concentrations. Therefore, groundwater remediation is not required and is not addressed in this FS report. Groundwater monitoring, however, will be included in the RAs for soil and the solid waste as part of the requirement of the landfill remedy.

Shallow groundwater at Site 11 is not a potable source and is not expected to be in the future. In accordance with the *Guideline for Groundwater Classification* under the USEPA Groundwater Protection Strategy dated December 19, 1986, the shallow water-bearing unit beneath Site 11 does not meet the requirements for classification as an aquifer. Site 11 was previously a wetland, which was filled in to create the existing topography. Under its natural setting prior to the filling in, the water would have existed as surface water associated with the wetland. Aerial photographs confirm the filling in of this area in the past.

The Upland Area will also not be addressed in this FS report. It will be addressed with Site 66, which is located upgradient of the Upland Area. Site 66 has been identified as one of the continuing sources of contamination in the Upland Area. Based on the RI soil borings and the geophysical survey, metal debris on the surface and in the subsurface of the Upland Area are also identified as the continuing source of contamination in this area.

2.3 Site-Specific RAOs

General RAOs are defined by the NCP and CERCLA (as amended by SARA), and are applicable to all CERCLA sites. CERCLA defines the statutory requirements for developing remedies.

Site-specific objectives relate to specific contaminated media and to potential exposure routes. Site-specific objectives, which require an understanding of the contaminants and the physical properties of their respective media, are based on an evaluation of the potential risks to public health, to the environment, and on the ARARs. The future protection of environmental resources and the means of minimizing long-term disruption to existing facility operations also are considered. The site-specific RAOs for Site 11 are:

1. Reduce or minimize human and ecological receptors' direct contact with the solid wastes in the former landfill in Area A.
2. Reduce or minimize exposures to COCs in soil that presumably pose unacceptable risks to human receptors in Area A.
3. Reduce or minimize potential risk to ecological receptors (e.g., benthic fishes) from sediment.
4. Minimize and control soil erosion and runoff to surface water and migration of COCs to Mattawoman Creek.

2.4 ARARs and TBC Criteria

2.4.1 ARARs

Section 121(d) of CERCLA states that remedial actions, carried out under Section 104 or secured under Section 106, must attain (or justify the waiver of) any federal or more-stringent state environmental standards, requirements, criteria, or limitations that are determined to be ARARs. Applicable requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. A requirement is applicable if the jurisdictional prerequisites of the environmental standard show a direct correspondence when objectively compared with the conditions at the site.

If a requirement is not legally applicable, it is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well-suited to the conditions of the site. A requirement that is relevant and appropriate must be met as if it were applicable. Relevant and appropriate requirements that are more stringent than applicable requirements take precedence. However, more discretion is allowed in determining relevant and appropriate requirements than in determining applicable requirements. The criteria for determining relevance and appropriateness are listed in 40 CFR Section 300.400(g)(2) [40 CFR 300.400(g)(2)].

Regulatory requirements are concerned only with substantive, not administrative, requirements of a statute or regulation. The substantive portions of the regulation are those requirements that pertain directly to actions or conditions in the environment. Examples of substantive requirements include quantitative health- or risk-based restrictions upon exposure to types of hazardous substances. Administrative requirements are the mechanisms that facilitate implementation of the substantive requirements. Administrative requirements include issuance of permits, documentation, reporting, record keeping, and enforcement. Thus, in determining the extent to which onsite CERCLA response actions must comply with environmental laws, a distinction should be made between substantive requirements, which may be regulatory requirements, and administrative requirements, which are not.

Furthermore, the regulatory requirements provision in CERCLA applies to onsite actions. "Onsite" is defined as the aerial extent of contamination, including groundwater plumes, to be remediated. According to CERCLA Section 121(e), a remedial response action that takes place entirely onsite may proceed without obtaining permits. This permit exemption applies to all administrative requirements. Offsite actions must comply with the substantive as well as the administrative requirements of all applicable regulations.

2.4.1.1 Chemical-Specific ARARs

Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set health- or RBC limits or discharge limitations for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied.

2.4.1.2 Location-Specific ARARs

Location-specific ARARs are those requirements that relate to the geographical or physical position of the site, rather than the nature of the contaminants or the proposed site remedial actions. These ARARs may limit the placement of remedial action, and may impose additional constraints on the cleanup action. For example, location-specific ARARs may refer to activities in the vicinity of wetlands, endangered species habitat, or areas of historical or cultural significance.

2.4.1.3 Action-Specific ARARs

Action-specific ARARs are requirements that apply to specific actions potentially associated with site remediation. Action-specific ARARs often define acceptable handling, treatment, and disposal procedures for hazardous substances. These requirements are triggered by the particular remedial activities selected to accomplish a remedy. Examples of action-specific ARARs include requirements applicable to landfill closure, wastewater discharge, hazardous waste disposal, and emissions of air pollutants.

2.4.2 TBC Criteria

A requirement may not meet the definition of regulatory considerations as described above, but still may be useful in determining whether to take action at a site or to what degree action is necessary, such as when no regulatory requirements exist for a site, action, or contaminant. Such requirements are called TBC criteria and are defined in 40 CFR Section 300.400(g)(3). TBC criteria are found in nonpromulgated advisories or guidance issued by federal or state governments that are not legally binding, but that may provide useful information or recommended procedures for remedial action. Although TBCs do not have the status of regulatory requirements, they are considered together with regulatory requirements to establish the required level of cleanup for protection of health or the environment. The critical difference between a TBC and regulatory considerations is that one is not required to comply with or meet a TBC when deciding on a remedial action.

2.4.3 ARARs and TBCs for Site 11

Potential chemical-specific, location-specific, and action-specific ARARs for Site 11 are summarized in Tables 2-1, 2-2, and 2-3. TBC criteria are included as appropriate for each classification.

The RAs developed in this report were analyzed for compliance with federal and state ARARs. The analysis involved identifying potential requirements for each of the RAs, evaluating their applicability or relevance, and determining whether they can achieve the ARARs. Results of that analysis are presented in Sections 4 and 5 of this report.

2.5 SRGs and COCs Requiring Remediation

SRGs for Site 11 were identified for all COCs in soil and sediment. For soil, SRGs were developed based on the greater of the site-specific, risk-based PRGs or background concentrations. The sediment SRGs were developed based on the risk-based PRGs. Following is a discussion on the development of the PRGs with subsequent development of the SRGs.

Risk-based PRG values were calculated for the constituents identified as COCs in soil and sediment. PRGs for the soil were calculated based on the non-carcinogenic human health risks, and the PRG for sediment was calculated based on the ecological risks. Details of the human health and ecological risk PRG calculations are included in Appendix F and Appendix G.

Zinc was the only COC identified in the BERA for the shoreline sediments. Calculation of the zinc PRG included consideration of ecological factors as described in the technical memorandum included in Appendix G. The calculated zinc PRG for sediments is 450 mg/kg, which also became the SRG.

Comparisons of the soil PRGs to the base-wide background concentration, the maximum detected concentrations, and the 95 percent upper confidence limit (UCL) of the datasets for Area A, Upland Area, and Area B are presented in Table 2-4. These comparisons were used to develop the SRGs and the COCs requiring remediation in soil. A COC was determined to require remediation if its maximum detected concentration and the 95 percent UCL exceeded its SRGs and the detections are considered isolated in nature.

Several metal COCs were identified for Area A and the Upland Area. These are arsenic, cadmium, copper, manganese, antimony, chromium, aluminum, silver, and zinc. Arsenic, cadmium, copper, and manganese were determined to require remediation because of SRG exceedances. Antimony and chromium, however, do not require remediation because their detections are isolated and infrequent. Aluminum, silver, and zinc were also determined to not require remediation because they did not exceed their respective SRGs.

For Area B soil, the maximum detected concentrations of thallium and vanadium were observed to be less than the base-wide background concentrations. The maximum detected concentrations and/or the exposure point concentrations for aluminum, antimony, arsenic, cadmium, chromium, copper, and manganese were less than the calculated risk-based PRGs, which were also the SRGs for these constituents. The detected concentrations of thallium and vanadium in soil were consistent with or less than background conditions. In summary, there are no unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil.

2.5.1 AA and Area of Remediation

The AA is defined as the area over which RAOs and, therefore, SRGs are to be met. An AA may not necessarily become the area of remediation, depending on the effectiveness, implementability, and cost for a particular RA.

One of the RAOs for Site 11 is to reduce or minimize direct contact of human and ecological receptors with the solid wastes in the former landfill in Area A and the Upland Area. Based on this RAO, the area in which buried solid waste was observed, regardless of any presence of SRG exceedances, was considered as an AA and area of remediation.

Although fill material/solid waste was observed at some of the boring locations in Area B, no remedial action will be proposed for this area for the following reasons:

1. The historical uses and contaminant sources for Area A and Area B are different. Landfilling and waste disposal occurred in Area A, and incineration or waste burning occurred in Area B. Historical records indicate that Area B was never used as a disposal area for solid waste.

2. Solid waste materials (wood, bricks, concrete, and pieces of plastic) observed in the borings are considered to be surficial because they are commingled with the surface soil and are inert.

3. As indicated in the Area B HHRA and Table 2-4, there are no potentially unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil. In addition, the technical memorandum submitted to IHIRT outlining the results of Area B HHRA (CH2M HILL, 2005c) recommended that remedial actions are not necessarily required for either soil or groundwater at Area B.

The no-remediation proposal for Area B was discussed with and agreed upon by IHIRT on October 6, 2005 (Appendix H). The Upland Area will be addressed in a separate installation restoration action with Site 66.

Figure 2-1 shows the approximate boundaries of the AAs based on the delineated extent of the solid waste and the exceedance of SRGs in Area A. The AA for soil encompasses an area of approximately 2.8 acres. Assuming the average waste thickness of 5 feet, the total volume equates to approximately 22,425 cubic yards (CY).

Figure 2-2 shows the AA based on the zinc SRG exceedances in the nearshore sediment of Site 11. For cost estimating purpose, the AA extended approximately 10 feet outward from the shoreline into the creek. The lateral extent of the AA to the eastern and western portions of the shoreline was approximated. The sediment AA was approximated at 10,300 square feet. Confirmatory sampling using field analytical method such as X-ray fluorescence (XRF) would be conducted during the remedial action to further delineate the SRG exceedance area.

TABLE 2-1
Chemical-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Chemicals & Relevant Media	Requirement	Prerequisites	Citation	ARAR or TBC	Comments
Groundwater, residential water supplies	Meet National Primary Standards for maximum contaminant levels (MCLs).	Drinking water source or potential potable source	Safe Drinking Water Act (SDWA): 40 CFR 141 National Primary Drinking Water Regulations, CERCLA, RCRA	Relevant and appropriate	Regulation does not apply where groundwater quality has concentrations of total dissolved solids (TDS) greater than 2,500 mg/L. In these instances, the Medium-Specific Concentration for groundwater may be multiplied by 100. MCLs are considered in the determination of SRGs for Site 11 groundwater.
Surface waters of the State	Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for discharges. Limitations and policy for antidegradation of the State's surface water.	Activities that will pollute the State's surface waters	COMAR 26.08, chapters 1 through 7	Applicable	This regulation is applicable for remedial actions that may affect surface water quality in the State of Maryland.
Soil as a source of groundwater contamination	Regulated substances are not to exceed the soil-to-groundwater pathway numeric value throughout the soil column.	Potential exposure to groundwater	CERCLA, EPA Region III RBC tables, and EPA soil-screening guidance (EPA/540/R-94/101)	TBC	Potentially applies at Site 11 where contaminants in soil are also present in groundwater at concentrations above PRGs. Used to define soil PRGs for Site 11.
Carcinogens in groundwater	Not to exceed media-specific concentration that causes a lifetime cancer risk of between 1 in 10,000 and 1 in 100,000.	Potential exposure	CERCLA, RCRA	TBC	Use to calculate site-specific PRGs for Site 11 groundwater.
Systemic toxicants in groundwater	Not to exceed media-specific levels where people could be exposed by direct ingestion or inhalation on a daily basis without appreciable risk of deleterious effects.	Potential exposure	CERCLA, RCRA	TBC	Use to calculate site-specific PRGs for Site 11 groundwater.

ARAR - Applicable or relevant and appropriate requirement
RCRA - Resource Conservation and Recovery Act
CFR - Code for Federal Regulations
CWA - Clean Water Act
EPA - U.S. Environmental Protection Agency
OSHA - Occupational Safety and Health Administration
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
SDWA - Safe Drinking Water Act
SMCLs - Secondary Maximum Contaminant Levels
TBC - To be considered

TABLE 2-2
Location-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Location	Requirement	Prerequisite	Citation	Applicability Determination	Comments
Federal Location-Specific ARARs					
Historic Sites, Buildings, and Antiquities Act					
Historic sites	Avoid undesirable impacts on landmarks.	Areas designated as historic sites.	16 USC 461-467; 40 CFR 6.301 (a)	Relevant and Appropriate	There are no records of historic landmarks at Site 11. These regulations are applicable only if this situation changes.
Endangered Species Act of 1973					
Critical habitat upon which endangered species or threatened species depend.	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior. Reasonable mitigation and enhancement measures must be taken, including live propagation, transplantation, and habitat acquisition and improvement.	Determination of effect upon endangered or threatened species or their habitat by conducting biological assessments.	16 USC 1531; 16 USC 1536(a); 50 CFR 81, 225, 402	Potentially applicable	There are no records of federal endangered plant and animal species located at NSF-IH. These regulations are applicable only if this situation changes.
Fish and Wildlife Coordination Act, Fish and Wildlife Improvement Act of 1978, Fish and Wildlife Conservation Act of 1980					
Area affecting streams or other water body	Provides protection for actions that would affect streams, wetlands, other water bodies or protected habitats. Any action taken should protect fish or wildlife.	Diversion, channeling or other activity that modifies a stream or other water body and affects fish or wildlife.	16 USC 661; 16 USC 662; 16 USC 742a; 16 USC 2901; 50 CFR 83	Applicable	Response actions will incorporate protection against any area water body, wetlands, or protected habitats.
Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act and Executive Order 11990, Protection of Wetlands					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands. Wetlands of primary ecological significance must not be altered so that ecological systems in the wetlands are unreasonably disturbed.	Wetlands as defined by Executive Order 11990 Section 7.	40 CFR 6, Appendix A, excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	This regulation may be an ARAR for activities occurring in areas that meet the definition of a wetland. Remedial activities must minimize the destruction, loss, or degradation of the wetlands.
Clean Water Act, Section 404					
Wetland	The degradation Section requires degradation or destruction of wetlands and other aquatic sites be avoided to the extent possible. Dredged or fill material must not be discharged to navigable waters if the activity: contributes to the violation of Maryland water quality standards; CWA Sec. 307; jeopardizes endangered or threatened species; or violates requirements of the Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Applicable	Wetlands and navigable waters are present in the vicinity of Site 11. Remedial activities will comply with the requirements of this section of the Clean Water Act.
Surface Water	Ambient Water Quality Criteria established to protect aquatic life and human consumers of water aquatic life.	Activities that affect or may affect the surface water onsite	40 CFR 129	Applicable	
Hazardous Waste Control Act (HWCA)					
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste; treatment, storage, or disposal of hazardous waste.	40 CFR 264.18 (b)	TBC	Portions of Site 11 are within the 100-year flood zones. However, actions are not expected to involve hazardous waste. This would be TBC for nonhazardous waste.
Executive Order 11988, Protection of Floodplains					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	Portions of Site 11 are within the 100-year flood zones, therefore the requirements of this regulation are applicable for any response actions that might involve the use of these areas.
State Location-Specific ARARs					
Threatened and Endangered Species					
Critical habitat upon which endangered species or threatened species depend.	Requires action to conserve endangered or threatened fish species and the critical habitats they depend on. May not reduce the likelihood of either the survival or recovery of a listed species in the wild by reducing the reproduction, numbers or distribution of a listed species or otherwise adversely affect the species.	Determination of effect upon endangered or threatened species or its habitat.	COMAR 08.03.08	Potentially applicable	There are no records of state or federal endangered or threatened plant and animal species located within NSF-IH, based on inquiries to the Maryland DNR. These regulations are applicable if this situation changes.
Threatened and Endangered Fish Species					
Critical habitat upon which endangered or threatened fish species depend.	Requires action to conserve endangered or threatened fish species and the critical habitats they depend on.	Determination of effect upon endangered or threatened fish species or its habitat.	COMAR 08.02.12	Potentially applicable	These regulations are applicable if remedial actions may jeopardize endangered or threatened fish species. Currently, there are no federal or state endangered fish species at NSF-IH.

TABLE 2-2
Location-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Location	Requirement	Prerequisite	Citation	Applicability Determination	Comments
Fish and Fisheries					
Fisheries, locations where species of fish exist	Requirements to conserve species of fish for human enjoyment, for scientific purposes and to ensure their perpetuation as viable components of their ecosystems.	Determination of effect upon fish species or its habitat.	Annotated Code of Maryland Title 4	Applicable	Fish species inhabit Mattawoman Creek. If response actions affect these species, the requirements of this title are applicable.
Wildlife					
Areas inhabited by wildlife	Requirements to conserve species of wildlife for human enjoyment, for scientific purposes and to ensure their perpetuation as viable components of their ecosystems.	Determination of effect upon wildlife species or its habitat.	Annotated Code of Maryland Title 10	Applicable	Wildlife species are present at NSF-IH. If response actions may affect these species, the requirements of this title are applicable.
Nontidal Wetlands Protection Act, Maryland Nontidal Wetlands Regulations					
Wetland	Provides regulations for activities on or near nontidal wetlands (an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions). Must obtain a permit from the State in order to conduct certain regulated activities in a nontidal wetland, or within a buffer or an expanded buffer.	Activities that will occur on or near nontidal wetlands.	COMAR 26.23; Annotated Code of Maryland, Title 5; Code of MD, Title 8-1201;	Applicable	Nontidal wetlands are present at Site 11. A permit or letter of exemption from the Department of Natural Resources is required if remedial activities involve activities on or in nontidal wetlands.
Wetlands and Riparian Rights					
Wetlands	Requiremetns to restore wetlands after distrubance.	Restoration of wetlands		Applicable	
Wetlands and Riparian Rights					
Wetlands	Requirements to preserve wetlands and prevent their destruction; requires a license for dredging or filling of wetlands.	Activities that can affect the integrity of wetlands, such as dredging or filling.	Annotated Code of Maryland Title 16	Applicable	Wetlands (tidal and nontidal) are present at Site 11. The requirements of this title are applicable for any response actions that may affect the integrity of these wetlands.
Construction on Nontidal Waters and Floodplains					
Nontidal waters and floodplains	Protect and maintain nontidal waterways and/or state of Maryland floodplains must follow these regulations	Activities that affect nontidal waterways and floodplains	COMAR 08.05.03	Potentially Applicable	Any remedial actions involving alteration to the streams bounding Site 11 or floodplains (including temporary construction) are subject to these requirements.
Maryland Tidal Wetland Act					
Tidal Wetlands	Requirements for filling, construction, and dredging of open water and vegetated wetlans and marsh establishment.	Activities that affect tidal wetlands	COMAR 26.24	applicable	Wetlands (tidal and nontidal) are present at Site 11. The requirements of this title are applicable for any response actions that may affect the integrity of these wetlands.
Water Pollution Control Law					
Waters of the State	Establishes effective programs and provides additional and cumulative remedies to prevent, abate, and control pollution of the waters in the state.	Activities that will pollute the waters in the state.	COMAR 9, Parts 301-351	Applicable	This regulation is applicable for remedial actions that may affect water quality in the streams around Site 11.
Maryland Water Pollution Control Regulations					
Surface waters of the State	Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for discharges limitations and policy for antidegradation of the State's limitations and policy for antidegradation of the State's surface water.	Activities that will pollute the surface waters of the state.	COMAR 26.08, Chapters 01-07	Applicable	This regulation is applicable for remedial actions that may affect surface water quality in the State of Maryland.
Water Management					
Water resources of the State	Provides for the conservation and protection of the water resources of the State by requiring that any land-clearing, grading, or other earth disturbances require an erosion- and sediment-control plan. Also provides that stormwater must be managed to prevent offsite sedimentation and maintain current site conditions.	Activities that affect the water resources of the State.	COMAR 26.17.01 COMAR 26.17.02, Annotated Code of Maryland Title 4	Applicable	The design for the remedial actions will incorporate the requirements of this regulation.

ARARs - Applicable or relevant and appropriate requirements.
RCRA - Resource Conservation and Recovery Act.
CFR - Code of Federal Regulations.
CWA- Clean Water Act.
DON - Department of Navy.
EO - Executive Order
FR - Federal Register.
HWCA - Hazardous Waste Control Act.
USC - United States Code.
TBC - To Be Considered.

TABLE 2-3
Action-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal Action-Specific ARARs					
Resource Conservation and Recovery Act (RCRA) 42 USC 6901 et seq.					
Onsite waste generation	Waste generator shall determine if waste is hazardous waste.	Generator of hazardous waste.	40 CFR 262.10 (a), 262.11	Applicable	Applicable for any operation where waste is generated. Remedial alternatives for Site 11 may generate contaminated wastes.
Hazardous waste accumulation	Generator may accumulate waste on site for 90 days or less or must comply with requirements for operating a storage facility.	Accumulate hazardous waste.	40 CFR 262.34	Potentially applicable	If waste generated at NSF-IH is determined to be hazardous, any storage of the hazardous waste will not exceed 90 days. Accumulation of hazardous wastes onsite for longer than 90 days would be subject to the substantive RCRA requirements for storage facilities.
Recordkeeping	Generator must keep records.	Generate hazardous waste.	40 CFR 262.40	Potentially applicable	Administrative requirements are not ARARs for onsite CERCLA actions.
Excavation	Movement of excavated materials to new location and placement in or on land will trigger land disposal restrictions for the excavated waste or closure requirements for the unit in which the waste is being placed.	Materials containing RCRA hazardous wastes subject to land disposal restrictions are placed in another unit.	40 CFR 268.40	Potentially applicable	Applicable to disposal of soil to a new location and placement in or on land containing land-disposal-restricted RCRA hazardous waste. The wastes generated from response actions at Site 11 NSF-IH may be RCRA hazardous wastes.
RCRA CAMU					
Solid Wastes	Regulations governing the Corrective Action Management Units (CAMU), which facilitate tratement, storage, and disposal of hazardous wastes managed for implementing cleanup.		40 CFR 260, 264, 268, 270, and 271 (need to verify which of these parts pertain to the CAMU)	Applicable	Delineates regulations governing the control systems and requirements to be implemented with the landfill cover.
RCRA Municipal Solid Waste Landfills					
Solid Wastes	Minimum requirements for a RCRA Subtitle D municipal solid waste landfill.	Operating criteria for municipal solild waste landfills	40 CFR 258.26	Applicable	Delineates regulations governing the control systems and requirements to be implemented with the landfill cover.
Safe Drinking Water Act					
Actions that affect drinking water supply	Promulgates National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs)	Actions that affect drinking water supply	40 CFR 141	Relevant and appropriate	These regulations are ARARs for remedial actions at Site 11 that affect the groundwater.
U.S. Department of Transportation, 49 USC 1802, et seq.					
Hazardous Materials Transportation	No person shall represent that a container or package is safe unless it meets the requirements of 49 USC 1802, et seq. or represent that a hazardous material is present in a package or motor vehicle if it is not.	Interstate carriers transporting hazardous waste and substances by motor vehicle. Transportation of hazardous material under contract with any department of the executive branch of the Federal Government.	49 CFR 171.2(f)	Potentially applicable	Offsite transport of hazardous materials must comply with both substantive and administrative requirements.

TABLE 2-3
Action-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
	No person shall unlawfully alter or deface labels, placards, or descriptions, packages, containers, or motor vehicles used for transportation of hazardous materials.		49 CFR 171.2(g)	Potentially applicable	
Hazardous Materials Marking, Labeling, and Placarding	Each person who offers hazardous material for transportation or each carrier that transports it shall mark each package, container, and vehicle in the manner required.	Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material.	49 CFR 172.300	Potentially applicable	To be determined. Offsite transport of hazardous materials must comply with both substantive and administrative requirements.
	Each person offering non-bulk hazardous materials for transportation shall mark the proper shipping name and identification number (technical name) and consignee's name and address.		49 CFR 172.301	Potentially applicable	
	Hazardous materials for transportation in bulk packages must be labeled with proper identification (ID) number, specified in 49 CFR 172.101 table, with required size of print. Packages must remain marked until cleaned or refilled with material requiring other marking.	Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material.	49 CFR 172.302	Potentially applicable	
	No package marked with a proper shipping name or ID number may be offered for transport or transported unless the package contains the identified hazardous material or its residue.		49 CFR 172.303	Potentially applicable	
	The marking must be durable, in English, in contrasting colors, unobscured, and away from other markings.		49 CFR 172.304	Potentially applicable	
	Labeling of hazardous material packages shall be as specified in the list.	Person who offers hazardous material for transportation; carries hazardous material; or packages, labels, or placards hazardous material.	49 CFR 172.400	Potentially applicable	
	Non-bulk combination packages containing liquid hazardous materials must be packed with closures upward, and marked with arrows pointing upward.		49 CFR 172.312	Potentially applicable	
	Each bulk packaging or transport vehicle containing any quantity of hazardous material must be placarded on each side and each end with the type of placards listed in Tables 1 and 2 of 49 CFR 172.504.		49 CFR 172.504	Potentially applicable	

TABLE 2-3
Action-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Occupational Safety and Health Administration (OSHA)					
Hazardous waste work	Requirements for hazardous waste workers such as training, personal protective equipment (PPE), and clothing must be met.	Hazardous waste work.	29 CFR 1904, 29 CFR 1910, 29 CFR 1926	Applicable	Remedial action activities at NSF-IH Site 11 will involve hazardous waste workers; therefore the requirements of OSHA must be met.
State Action-Specific ARARs					
Maryland Hazardous Waste Regulations					
Storage, treatment or disposal, and transportation of hazardous waste	Regulations and procedures for the identifications, listing, transportation, treatment, storage, and disposal of hazardous wastes must be met.	Handling of hazardous wastes	COMAR 26.13.01 through COMAR 26.13.04, Annotated Code of Maryland Title 7	Potentially Applicable	Any hazardous waste found during site remediation will be disposed of according to regulations. Any residues or by-products from treatment systems that are hazardous must be disposed of properly.
Solid Waste Management - Landfill Closure					
Sanitary Landfill Closure	Requirments for landfill closure	Design specifications of various closure caps	COMAR 26.04.07.21	Applicable	The requirements of this regulation is applicable for the design of soil cover and the impermeable cap to address the solid waste and soil at Site 11.
Solid Waste and Water Supply Regulations					
Well Construction and Abandonment	Specifications for well construction and abandonment must be met. Also provides a mechanism to provide the State of Maryland with a database of existing and abandoned wells. Permits are required for well construction.		COMAR 26.04.03 (A&D); COMAR 26.04.04	Applicable	The requirements of this regulation are applicable to the response actions at Site 11 if monitoring wells have to be installed or abandoned.
Stormwater Management					
Design and construction	Regulations require the design and construction of a system necessary to control stormwater.	Design and construction activities	COMAR 26.17.02	Applicable	The remedial action will incorporate measures to control and manage stormwater as necessary.
Erosion and Sediment Control					
Land clearing, grading, and earth disturbances	Regulations require the preparation and implementation of a plan to control erosion and sediment for activities involving land clearing, and grading and earth disturbances. Erosion and sediment control criteria are also established.	Land clearing, grading, and earth disturbances	COMAR 26.17.01	Applicable	The remedial action will incorporate the standards required for clearing, grading, and other earth disturbances, including compliance with county and municipal erosion and sediment control ordinances, and the Commission's erosion- and sedimentation-control regulations.
Maryland Drinking Water Law					
Actions that affect state drinking water	Ensures that the State has the primary enforcement responsibility for drinking water standards under the Federal Safe Drinking Water Act.	Action causing pollution of drinking water supply	COMAR 9.04, Parts 401-413	Applicable	This regulation may be an ARAR for Site 11 if activities that affect water quality are conducted.

TABLE 2-3
Action-Specific ARARs
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Maryland Tidal Wetland Act					
Tidal Wetlands	Requirements for filling, construction, and dredging of open water and vegetated wetlans and marsh establishment. Permit requirements for marsh establishment.	Permitting process for marsh establishment	COMAR 26.24	Applicable	Compliance for disturbance and establishment of a tidal wetland.
Occupational, Industrial, and Residential Hazards					
Action that will generate noise	Limits set on the levels of noise must be met; these limits are protective of the health, welfare, and property of the people in the State of Maryland. The maximum permitted levels for construction activities may not exceed 90 dBA during the day and 75 dBA during night.	Action that will generate noise	COMAR 26.02.03.02A (2) and B(2), COMAR 26.02.03.02.03A, Annotated Code of Maryland Title 3	Applicable	During site remediation work, the maximum allowable noise levels will not be exceeded at site boundaries.
Air Quality					
Actions that involve emissions to air	Provides ambient air quality standards, general emissions standards, and restrictions for air emissions from construction activities, vents, and treatment technologies such as incinerators. Also includes nuisance and odor control. Construction activities may emit particulate matter into the ambient air. Remedial activities must follow regulations.	Actions that involve emissions to air above specific limits.	COMAR 26.11	Applicable	May apply to earthwork activities that potentially generate particulate emissions.

Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific potential ARARs are addressed in the table below each heading.
Acronyms used in the table:

ARAR - Applicable or relevant and appropriate requirement
CAA - Clean Air Act
RCRA - Resource Conservation and Recovery Act
CFR - Code for Federal Regulations
CWA - Clean Water Act
DOT - U.S. Department of Transportation
EPA - U.S. Environmental Protection Agency
NPDES - National Pollutant Discharge Elimination System.
OSHA - Occupational Safety and Health Administration
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
SDWA - Safe Drinking Water Act
SMCLs - Secondary Maximum Contaminant Levels
TBC - To be considered
USC - United States Code

TABLE 2-4
Comparison of Site Data, Background Concentrations, PRGs for COCs in Soil
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

COC	Max. Detection (mg/kg)	Site 95% UCL	Risk-Based PRG	Facility-wide Background Conc. (mg/kg)	Comment	SRG (mg/kg)	# of Samples > SRGs – Range of Exceedance	Requiring Remediation?
Area A and the Upland Area								
Aluminum	25,600	11,326	38,000	11,500	Max < PRG	38,000	0	No
Antimony	19	13	14	1.8	Max > PRG, Background; UCL < PRG	14	4 - (14.6 – 18.9 mg/kg)	No – Isolated detections. However, they are within the solid waste area.
Arsenic	42.7	11	7.3	18.3	Max > PRG UCL< Background	18.3	4 - (21.8 – 42.7 mg/kg)	Yes
Cadmium	147	74	36	0.18	Max > PRG, Background	36	6 - (39.9 – 147 mg/kg)	Yes
Chromium	156	42	130	46.5	Max > PRG, Background; UCL < PRG	130	2 - (143 and 153 mg/kg)	No – isolated detections. However, they are within the solid waste area.
Copper	4,960	2,150	1,500	26	Max > PRG, Background	1500	3 - (1,840 – 4,960 mg/kg)	Yes
Manganese	1,330	403	533	266	Max > PRG, Background; UCL < PRG	533	6 - 595 – 1,330 mg/kg)	Yes
Silver	62.5	29	88	2.2	Max < PRG	88	0	No
Zinc	10,000	4,663	11,500	70	Max < PRG	11,500	0	No
Area B								
Aluminum	23,400	10,850	38,000	11,500	Max < PRG	38,000	0	No
Antimony	9.5	7.3	13	1.8	Max < PRG	13	0	No
Arsenic	25	15	22	18.3	UCL < PRG	22	3 - (23.4 – 25.5 mg/kg)	No – isolated detections and 95% UCL was below SRG.
Cadmium	20	11	37	0.18	Max < PRG	37	0	No
Chromium	151	59	110	46.5	UCL < PRG	110	1 - (151 mg/kg)	No – isolated detection
Copper	1,380	467	3,000	26	Max < PRG	3,000	0	No
Manganese	733	392	460	266	UCL < PRG	460	4 - (566 – 733 mg/kg)	No – isolated detection and 95% UCL was below SRG.
Note: Background concentrations 95% UCL (TetraTech NUS, 2002).								

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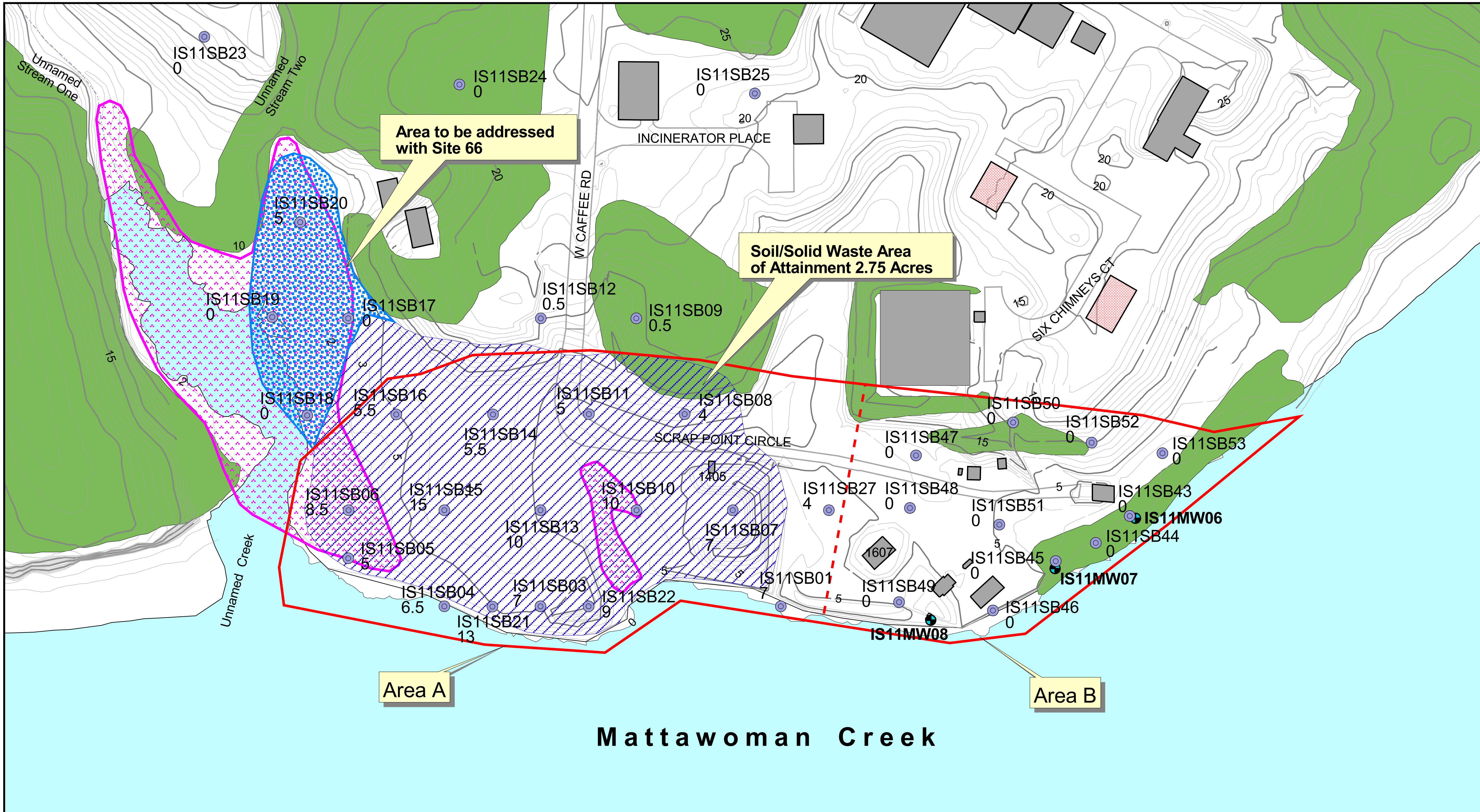

LEGEND

- Soil Boring
- Monitoring Well
- Stream
- Approximate Site Boundary
- Buildings
- Demolished Buildings
- Roads

5.5 = Estimated Thickness of Waste (feet)

- Topographic Index Contours (5 foot Intervals)
- Wooded Area
- Wetland Area
- Limits of Waste
- Area to be addressed with Site 66

N

0 100 200 Feet

Figure 2-1
Soil/Solid Waste Area of Attainment
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

CH2MHILL

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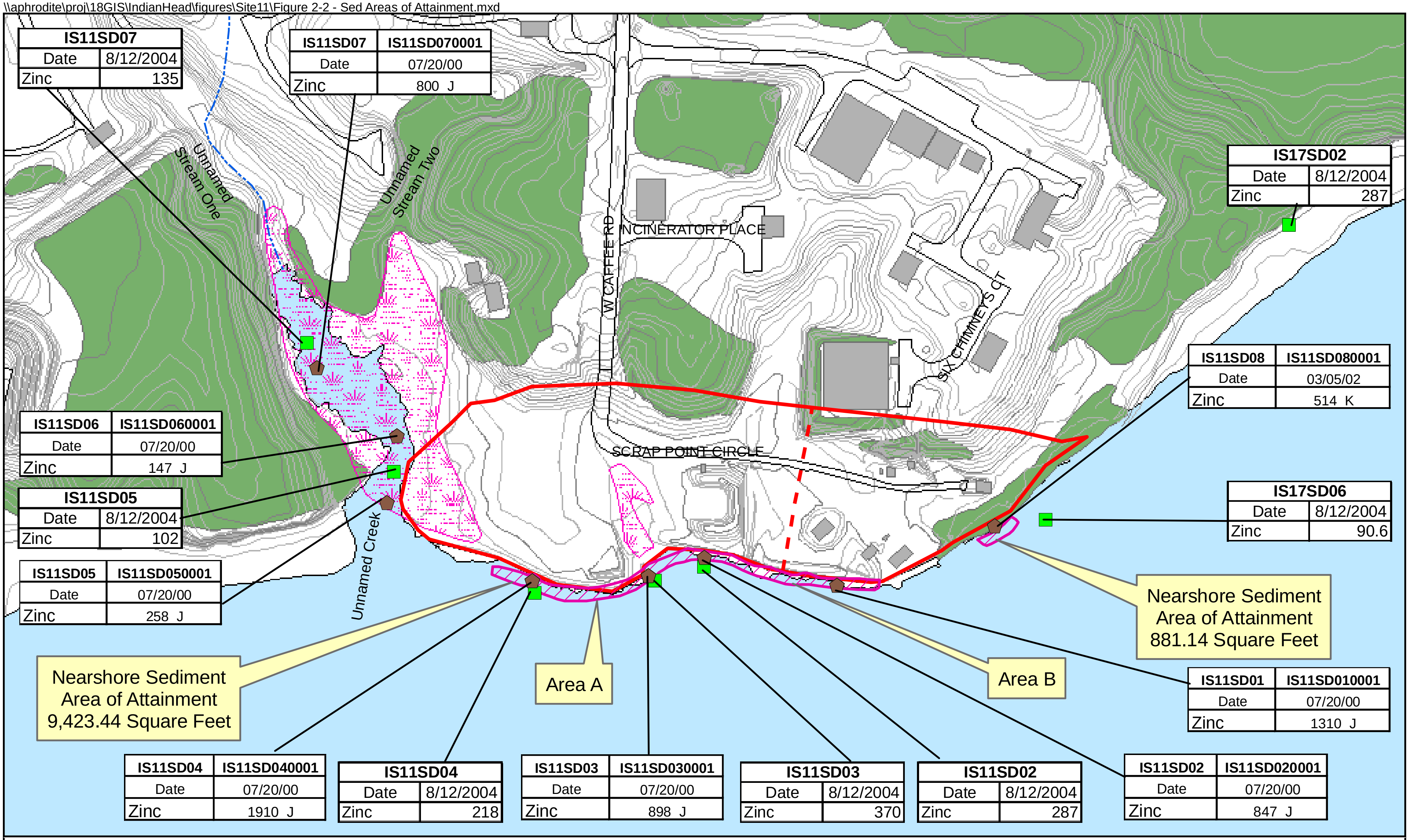

Legend

- Sediment Samples
- BERA Samples
- Sediment Area of Attainment
- Wetland Areas
- Approximate Site Boundary
- Boundary Between Area A and Area B
- Buildings
- Wooded Area
- Roads
- Stream

K = Biased High
J = Estimated Value Below the Detection Limit
mg/kg = Milligrams per kilogram

-Area A Sampled July 2000 - August 9, 2000
-Area B Sampled February 25, 2002 - March 26, 2002

N W E S

0 100 200 Feet

Figure 2-2
Sediment Areas of Attainment
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

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SECTION 3

Screening of Remedial Technologies and Development of RAs

An overview of the process used to identify and screen technologies is provided in this section, and the results of the screening process are summarized. Technologies and process options applicable to each identified General Response Action (GRA) were evaluated for effectiveness, technical implementability, and relative cost. Technologies and process options that are not effective in protecting human health and the environment, that cannot be implemented because of the physical characteristics of the site or contaminants, or that have a cost that is an order of magnitude greater than a similar technology were eliminated during this phase of the screening.

This section discusses the GRAs developed to address the RAOs outlined in the previous section. Potential remedial technologies and specific process options, which underwent a primary screening to determine their suitability as part of an RA, are identified and described for each GRA.

A description of the general technology groups and process options is provided in the following sections. Table 3-1 presents a summary of the remedial technologies and process options identified for remediating soil and solid waste. Table 3-2 presents the summary for sediment.

3.1 Identification and Screening of GRAs

GRAs are broad classes of responses or remedies developed to meet the site-specific RAOs. Each GRA is intended to address specific constituents and their possible migration pathways and exposure routes. Although an action may be capable of meeting an objective, combinations of actions may be more cost-effective in meeting all the objectives. The GRAs listed below have been identified as being potentially applicable for Site 11 solid waste, soil, and sediment:

Solid Waste, Soil, and Nearshore Sediment in Area A:

- No Action
- Institutional Controls (ICs)
- Long-term Monitoring for Groundwater[1]
- Containment
- Removal and Off- or Onsite Disposal
- *In situ* Treatment

Nearshore Sediment in Area B:

- No Action
- ICs
- Containment
- Long-term monitoring
- Source Control (removal of metal debris on the shoreline of Mattawoman Creek)
- Removal and Off- or Onsite Disposal

[1] Per the State of Maryland, long-term groundwater monitoring is required under the soil cover or capping remedy regardless of the absence of groundwater risks.

- **No Action**—As required by the NCP, the no-action response is included in the evaluation for all media as a baseline for evaluating the RAs. No attempt is made to satisfy the RAOs, and no remedial measures are implemented.
- **ICs**—Actions using physical, legal, or administrative mechanisms to restrict the use of, and limit access to, contaminated media.
- **Long-Term Monitoring**—Media are sampled at specified locations to monitor the transport and concentrations of contaminants over time.
- **Containment**—Actions that result in contaminated soil, sediment, and/or groundwater being contained or controlled, thereby minimizing or eliminating the migration of contaminants and preventing direct exposure to contamination. For soil and solid waste, containment may involve constructing a physical barrier that breaks the contact exposure pathway and reduces rainwater infiltration through the soil and/or solid waste, such as various capping options. Lastly, for sediment, containment refers to in-situ capping, whereby a sub-aqueous covering or cap of clean materials are placed over contaminated sediment that remain in place.
- **Removal and Offsite or Onsite Disposal**—Actions taken to physically remove contaminated soil, solid waste, or sediment from the site and dispose of the material in an offsite permitted disposal facility or onsite facility.
- ***In situ* treatment**—Actions taken to treat contaminated soil and solid waste in place to reduce the toxicity, mobility, and/or volume of contaminants, such as *in situ* stabilization of soil and solid waste.
- **Source Control**—Actions taken to control the continuous source of contamination by either removal or *in situ* treatment. Identifying and controlling contaminant sources are critical to the effectiveness of any remediation.

In situ treatment for sediment was not considered because techniques for *in situ* treatment of sediment are in their infancy, and few methods are currently commercially available.

3.2 Identification and Screening of Remedial Technologies and Process Options

The next step in the FS process is to identify remedial technologies and process options for each GRA. *Remedial technologies* are general categories of technologies, such as chemical treatment, thermal destruction, or immobilization. *Process options* are specific processes within each technology type. For example, the chemical treatment remedial technology includes process options such as precipitation, ion exchange, and oxidation/reduction. The Technology Screening Matrix developed by the Federal Remediation Technologies Roundtable[2], the NAVFAC Environmental Restoration and Base Realignment and Closure Technology Web site[3], the USEPA Contaminated Sediment Remediation Guidance (USEPA,

[2] http://www.frtr.gov

[3] http://enviro.nfesc.navy.mil/scripts/WebObjects.dll/erbweb

2005b), and other sources were used in the preliminary identification of technologies and process options.

Technologies and process options that potentially apply to Site 11 were screened on the basis of their effectiveness, implementability, and relative cost for treating the COCs. Specific remedial technologies or process options were evaluated on the basis of their potential performance relative to other remedial technologies and process options within the same GRA.

Effectiveness. USEPA guidance for conducting FS studies (USEPA, 1988) uses “effectiveness” as the most important criteria at this stage. Less weight is given to cost and implementability. The technologies and process options retained following screening for effectiveness, implementability, and cost are retained for detailed evaluation under an expanded set of evaluation criteria.

In accordance with USEPA guidance (USEPA, 1988), representative process options were selected to simplify the development and evaluation of alternatives. However, the specific process option used to implement a remedial action may not be selected until the remedial design phase has been completed. Selection of a representative process option does not preclude the application of other retained process options at the site.

In the screening process, effectiveness pertains to the following:

- The capability of the technology to attain RAOs
- The capability of a remedial technology to handle the estimated areas or volumes of remediation target and to prevent or minimize the release of hazardous substances to potential receptors
- The degree of protection afforded to human health and the environment during construction and implementation of the remedial technology
- The reliability and performance of the technology with respect to the site conditions

Implementability. Implementability pertains to the following:

- The availability and capacity of treatment, storage, and disposal services
- The constructability of the remedial technology under facility conditions
- The time needed to implement the remedial technology, to achieve beneficial results, and to satisfy the RAOs.

Cost. Relative cost screening considers the general capital and operation and maintenance (O&M) costs associated with the process options. During the screening phase, detailed, site-specific cost estimates were not developed. The relative cost of process options was considered only if the cost of an option was believed to be significantly higher than the cost for other process options comparably effective or implementable.

Tables 3-1 and 3-2 present the screening of the technologies and process options for the solid waste and soil and the nearshore sediment at Site 11, respectively. Where possible, a single process option was selected as representative of a GRA. In some cases, more than one process option was selected because the options could not be differentiated in terms of effectiveness, implementability, or relative cost. As seen in these tables, in addition to no action, the retained technologies are:

Solid Waste, Soil, and Nearshore Sediment in Area A:

- ICs including groundwater monitoring
- Soil Cover
- RCRA C Cap
- Excavation and Offsite Disposal
- Excavation and Onsite Disposal

Nearshore Sediment in Area B:

- ICs
- Long-Term Monitoring
- *In situ* Capping

3.3 Development of RAs

The remedial technologies and process options that passed the initial screening process were assembled into RAs for soil and sediment.

The RAs for the soil, solid waste, and the nearshore sediment in Area A are:

- **Alternative 1—No Action**: This alternative is required by NCP as a baseline. Alternative 1 involves no planned actions for soil, solid waste, and/or groundwater.

- **Alternative 2—Protective Soil Cover, Institutional Controls (ICs), and Groundwater Monitoring:** This alternative involves installing a soil cover, regrading the site, stabilizing the shoreline to manage runoff and eliminate human and ecological exposures, implementing ICs, and groundwater monitoring. IC measures include land- and groundwater-use restrictions.

- **Alternative 3—RCRA Equivalent Subtitle C Cap, ICs, and Groundwater Monitoring:** This alternative is similar to Alternative 2 except that a RCRA Equivalent Subtitle C Cap would be installed instead of a soil cover.

- **Alternative 4—Excavation, Offsite Disposal, and Wetland Creation:** This alternative involves excavation of the solid waste and contaminated soil within the landfill area and offsite disposal. The excavation site would be restored as a tidal wetland. No ICs would be anticipated because all solid waste and contaminated soil would be removed from the site.

Because the former landfill abuts Mattawoman Creek, shoreline stabilization will be an integral part of Alternatives 2 and 3. Based on the comments provided on the Draft FS Report, the Biological Technical Assistance Group (BTAG) recommended a vegetation-based, or "living," shoreline stabilization measure, which was believed to be more environmentally enhancing than riprap or "hard" shoreline protection as proposed in the Draft FS Report. Furthermore, the riprap shoreline stabilization would involve removing portions of the existing rubble that currently serves as the shoreline stabilization. Because of the presence of potential MEC objects at Site 11, the rubble removal would require an approved explosives safety submission (ESS) document and MEC clearance, handling, and management support, which would increase the safety risk to the remediation workers and the potential for lengthy project delays.

To satisfy BTAG's recommendation, CH2M HILL evaluated and compared six additional shoreline stabilization alternatives to the riprap shoreline option presented in the Draft FS Report as the baseline. The evaluation and comparison were presented in a technical memorandum, *Comparative Analysis of Shoreline Stabilization and Nearshore Sediment Remediation Alternatives, Site 11, NSF-IH, Indian Head, Maryland,* dated December 3, 2007. This memorandum is presented in Appendix I. During the conference call on March 7, 2008, IHIRT agreed that the most applicable shoreline stabilization measure would entail extending the landfill cover toe into the creek to establish a wetland area on the landfill cover toe. This alternative will also address the nearshore sediment contamination in Area A because the landfill toe would be extended between 30 and 40 feet into the creek, providing cover for the contaminated nearshore sediment. Therefore, if Alternative 2 or 3 were selected for Site 11 to mitigate the contamination associated with the soil/solid waste, a portion of the nearshore sediment AA (shown in Figure 2-2) that is adjacent to Area A (approximately 5,000 SF) will be addressed by the soil/solid waste remedy. Similar benefits would be realized if Alternative 4 were selected.

The RAs for nearshore sediment in Area B are:

- **Alternative 1—No Action**: This alternative is required by NCP as a baseline. Alternative 1 involves no planned actions for sediment.
- **Alternative 2—Long-Term Monitoring and ICs**: This alternative involves long-term sediment monitoring for zinc, and implementation of ICs, such as prohibiting vessel anchoring and establishing a no-wake zone. The attenuation of zinc concentrations in sediment would depend entirely on natural recovery processes.
- **Alternative 3—*In situ* Capping and ICs**: This alternative involves installing a clean cover (e.g., a gravel blanket) over the nearshore sediments in Area B to contain zinc-contaminated materials and implementing IC measures, such as prohibition of vessel anchoring.

TABLE 3-1

Screening of Remedial Process Options for Solid Waste and Soil

Site 11 Feasibility Study

NSF-IH, Indian Head, Maryland

General Response Action	Remedial Action or Technology	Process Options	Effectiveness	Implementability	Relative Cost	Evaluation Action: Retain	Evaluation Action: Reject	Screening Comments
No Action	None	Not applicable	Does not protect human health or the environment Does not satisfy RAOs	Easily implemented	Low	X		Retain as baseline alternative
Institutional Controls	Administrative restrictions	Land use, access, and groundwater use restrictions, including long-term groundwater monitoring	Effectiveness depends on continued future implementation regardless of property use or ownership. Does not reduce contaminant levels but effective in minimizing human exposures	Easily implemented on NSF-IH property	Low	X		Could be used with other remedial alternative(s) until RAOs are met
Containment	Capping	RCRA Subtitle C Cap	Highly effective minimizing human exposures and in preventing migration of the solid waste and contamination from the site as long as the integrity of the cap is maintained Indirectly mitigate the human health risks posed by groundwater through reduction of water infiltration	Easily implemented	High capital, Moderate O&M	X		Conservative alternative since the solid waste within the landfill has not been fully characterized
		Protective Soil Cap/Cover	Adequate effectiveness in minimizing human exposures and in preventing migration of contamination from the site as long as the integrity of the cover is maintained	Easily implemented	Moderate capital, Low to Moderate O&M	X		Demonstrated effectiveness under existing conditions Risks can be managed effectively through institutional controls
In-situ Treatment	Physical/Chemical Treatment	Solidification / Stabilization	Will not be effective for heterogeneous landfill content, primarily large pieces of debris Potentially efficitive for contaminated soil in Area B but could interrupt the groundwater flow	Implementable, though will likely require bench and pilot scale testing	High to very high capital, Low O&M		X	Difficult to verify its effectiveness for the solid waste because of the varied characteristics of the waste The affect of solidification of the soil on groundwater flow would need to be evaluated
Removal and Off-site Disposal	Excavation and Off-site Landfill Disposal	Excavation and Off-site Landfill Disposal	Highly effective, waste and contaminated soil will be removed and disposed of at a permitted off-site landfill	Implementable	Very high due to transportation and potential disposal costs Zero O&M.	X		Retain to present worst-case scenario
Removal and On-site Disposal	Excavation and On-site Disposal	Excavation and On-site Disposal	Highly effective, waste and contaminated soil will be removed and disposed of at a designated on-site area; for example, if Area A is capped, this technology would apply to the Upland Area with disposal under the Area A cap	Implementable	Moderate capital, Low to Moderate O&M	X		Potentially practicable and cost attractive

TABLE 3-2
Screening of Remedial Process Options for Sediment
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

General Response Action	Remedial Action or Technology	Process Options/Description	Effectiveness	Implementability	Relative Cost	Evaluation Action: Retain	Evaluation Action: Reject	Screening Comments
No Action	None	Not applicable	Does not protect human health or the environment Does not satisfy RAOs	Easily implemented.	Low	X		Retain as baseline alternative
Containment	Capping	In-situ Capping - a subaqueous covering or cap of clean materials are placed over contaminated sediment that remain in place	Adequate effectiveness in minimizing ecological exposures and in preventing migration of contamination from the site as long as the integrity of the cover is maintained	Fairly easy to implement	Moderate capital; low to moderate O&M due to long-term commitment for maintaining the integrity of the cap	X		Containment can be implemented as part of the living shoreline stabilization. Implementation is logistically and administrativly simple.
Instituonal Controls	Institutional Controls	ICs - waterway use restrictions, such as restricting boat traffic, establishment of a no-wake zone, and prohibiting anchoring of vessels	Effective in maintaining the isolation of contaminated sediment through containment or natural recovery	Easily implemented	Low to moderate	X		Can be effective Requirements under soil cover or cap option
Source Control	Source Removal	Removal of exposed metal debris from the near shore sediment along Site 11	Highly effective; removal will eliminate the continuous source for zinc in the near shore sediment	Poor implementatiblity due to the administrative and procedure requirements related to the MEC management	Low to moderate		X	Increased risk due to potential of encountering munitions.
Long Term Monitoring and Natural Recovery	Long Term Monitoring and Natural Recovery	Long Term Chemical Monitoring of near shore sediment for zinc Reliance on processes, such as biotic or abiotic transformations, adsorption or binding of metals, burial and mixing with clean sediment, and physical transports (dispersion, diffusion, and advection)	Adequate effectiveness in reducing the concentrations over time Does not prevent exposure of ecological receptors to the sediments	Easily implemented	Low capital cost; moderate O&M cost	X		Attractive because of the extent of the SRG exceedance is limited to the near shoreline and concentrations are considered low
Removal and Off- or On-site Disposal	Excavation and Off- or On-site Landfill Disposal	Excavation and Off- or On-site Landfill Disposal	Highly effective, waste and contaminated sediments will be removed and disposed of at a permitted off-site landfill or placed under the capped portion of Site 11.	Poor implementatiblity due to the administrative and procedure requirements related to the MEC management	Moderate to high capital cost due to transportation, sediment control, and potential disposal costs; zero O&M		X	Risk is high due to the potential for encoutering munitions. Additionally, cost is much greater than other alternatives.

Notes:

In-situ technologies were not considered because the emergent nature of most in-situ technologies for sediment (USEPA, 2005).

SECTION 4

Descriptions and Detailed Analysis of RAs

The RAs discussed in Section 3 are further described and evaluated in this section. Additional screening of RAs was not necessary because of the limited number of technologies remaining following the technology screening discussed in Section 3.

4.1 Descriptions of RAs

Details of the RAs are presented in this section. Under all alternatives, a contingency plan would be evaluated if migration of contamination to the unaffected media or groundwater were found to occur, causing unacceptable risks to human health and the environment under reasonable current and future land use scenarios. In addition, CERCLA statutory 5-year reviews would be conducted under all alternatives.

4.1.1 Soil, Solid Waste, and Nearshore Sediment in Area A

4.1.1.1 Alternative 1—No Action

The no-action alternative is required by the NCP and serves as the baseline alternative. All other remedial action alternatives are judged against the no-action alternative. Under this alternative, no controls or remedial technologies will be implemented. In accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (USEPA, 2000), costs associated with the 5-year reviews were not included in this alternative.

4.1.1.2 Alternative 2—Protective Soil Cover, ICs, and Groundwater Monitoring

The following activities would be performed under Alternative 2 for soil and solid waste:

- Constructing 2 feet of soil cover in Area A, consisting of 18 inches of clean fill and 6 inches of top soil or top soil created using Class "A" pelletized sewage sludge per Code of Maryland Regulations (COMAR) 26.04.07; the seed mixture for the cover vegetation will be designed so that it will serve as a bio-barrier to burrowing animals.
- Restoring of the non-wetland impacted area to its original grade.
- Constructing surface water management drainage for the soil cover.
- Stabilizing the existing shoreline by partially removing surface rubble from the top of slope, creating a rock and gravel foundation fill to the high tide level, installing an earth fill to extend the soil cover over the remaining rubble and foundation fill, installing a permanent high-velocity erosion control matting, and vegetating the slope with wetland plants and native grasses. The newly established wetland slope will extend approximately 30 to 40 feet into the creek from the current shoreline, thereby indirectly providing cover for the nearshore contaminated sediment in Area A.
- Continuously implementing land use controls, including land-use and groundwater use restrictions.

- Performing groundwater quality monitoring.
- Conducting five-year reviews.

The cover will be constructed to meet the following specifications:

- The material must have a hydraulic conductivity no greater than 1×10^{-5} centimeters per second (cm/sec), or equivalent permeability of natural soil present, whichever is less.
- The infiltration layer must contain at least 18 inches of earthen material.
- The erosion control layer must be at least 6 inches of earthen material capable of sustaining native plant growth.

Figures 4-1 and 4-2 depict the conceptual design of Alternative 2.

The Hydrologic Evaluation of Landfill Performance (HELP) model (USEPA, 1994) was used to evaluate the reduction of water infiltration achieved by a soil cover at Site 11. HELP is a computer program that models movement of water through landfills and assists in the comparison of design alternatives for landfills. For this purpose, the HELP model results from Site 21 are considered applicable for Site 11 because of the similar fill setting. The preliminary prediction using the HELP model was that infiltration reduction with a soil cover would be minimal compared to the existing condition. Because most of the solid waste volume lies below the water table, as shown in Figure 1-4, reducing water infiltration would provide little, if any benefit.

For cost estimating purposes, the proposed area for the soil cover is approximately 2.8 acres and the design lifetime of the cover is assumed to be 30 years. Because of the past and ongoing mission of NSF-IH, the potential exists that ordnance could be encountered during the excavation activities. For this reason, a munitions and explosives of concern (MEC) avoidance survey and clearing are included in the cost estimate, as well as the labor costs associated with MEC excavation and disposal activities and the development of an after-action report. No costs were included in the alternative estimate for the treatment, transportation, demilitarization, and disposal of MEC.

Throughout the 30-year duration, IC measures such as access restrictions and prohibitions of any intrusive activities that will compromise the integrity of the soil cover will be enforced. For cost estimating purposes, groundwater monitoring is assumed to be performed quarterly for the first 3 years, annually for the remaining years up to the first 5 years. The need for the groundwater monitoring beyond the first 5 years will be determined based on the results of the first 5-year review.

Samples were assumed to be taken from seven existing monitoring wells and analyzed for a full suite of total and dissolved metals. Three monitoring wells may need to be abandoned and relocated because they are located within the proposed soil cover area. In addition, to assess the geochemical conditions of the groundwater and the potential for mobilization of metals (as the primary COCs), groundwater samples will be analyzed for geochemical parameters, such as oxidation/reduction potential , pH, dissolved oxygen, temperature, conductivity, ferrous iron (iron II), nitrate, sulfate, and methane, ethane, ethene (MEE). Nitrate, sulfate, and MEE are laboratory parameters, and the remaining geochemical parameters are field parameters. A detailed description of the monitoring program will be included in the long-term monitoring plan, which will be prepared after the ROD is signed.

For cost estimating purposes, the long-term maintenance activities primarily consists of mowing and field inspections, which are assumed to be performed semiannually for the duration of 30 years.

4.1.1.3 Alternative 3—RCRA Equivalent Subtitle C Cap, ICs, and Groundwater Monitoring

This alternative involves similar activities as Alternative 2, except the type of capping to be installed would be a RCRA Equivalent Subtitle C cap. In addition, approximately 480 CY of soil excavated during the NTCRA at Site 17 will be consolidated under the Area A cap. Figure 4-1 depicts the conceptual design for Alternative 3.

RCRA capping works by maintaining a multi-layer, low-permeability cover over the waste to stabilize surface soil and reduce surface water infiltration. The RCRA Subtitle C multilayered landfill cap is a baseline design that is suggested for use in RCRA hazardous waste applications. USEPA’s model cap configuration, which has been considered the RCRA-compliant standard since 1982, consists of the following (from top to bottom):

- A 24-inch-minimum protective cover and vegetative support layer consisting of 18 inches of general soil fill overlain by 6 inches of topsoil
- A drainage layer consisting of 12 inches of sand with a minimum hydraulic conductivity of 1 x 10^{-2} cm/sec, or equivalent, with adequate piping to maintain less than 1 foot of head on the barrier system
- A composite barrier layer consisting of a geomembrane and a minimum of 2 feet of compacted clay with a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec, or equivalent
- A gas collection layer consisting of 12 inches of sand, or equivalent, with adequate piping and vents to dissipate gases generated by the waste materials

However, USEPA has typically provided variances from these standards, provided that it can be demonstrated that the proposed cover system meets the performance objectives of the RCRA-compliant cap. For Site 11, a composite drainage net material would be used instead of the 12-inch sand layer for the drainage and gas collection layer and a geosynthetic clay liner material would be used instead of the 2-foot compacted clay layer because of the limited availability of suitable clay in the area. In addition, the cap would be constructed without a gas collection layer because the solid waste is not expected to produce gas. The use of the geonet and geosynthetic clay liners would significantly reduce the total thickness of the cap without compromising its function. No piping is required because of the small size and configuration of the area.

The HELP model results indicated that a full RCRA Equivalent Subtitle C Cap would likely reduce the water infiltration rate by 99.8 percent compared to the existing condition. However, because most of the solid waste lies below the water table, little, if any, benefit from reduced water infiltration would be expected by installing a RCRA Equivalent Subtitle C Cap at Site 11.

Similar to Alternative 2, long-term groundwater monitoring and surface water control will be implemented in conjunction with this alternative. The design lifetime of the cap is 30 years.

4.1.1.4 Alternative 4—Excavation, Offsite Disposal, and Wetland Creation

This alternative involves excavation of the solid waste and contaminated soil within Area A and offsite disposal of the excavated material to a permitted offsite landfill. Because the AA for soil and solid waste was primarily dictated by the presence of fill or solid waste, the edge of excavation would be confirmed through the absence of fill or solid waste during the visual inspection. The excavation area would be backfilled with a clean material and topsoil and restored as a wetland. Alternative 4 will indirectly mitigate the nearshore sediment contamination in Area A because this area would become part of the newly created wetland. Creation of a wetland would not only reduce the amount of clean fill materials needed and the associated transportation cost, but also would generate ecological benefits from creation of a new habitat. Potentially, the created wetland could be set aside as a wetland mitigation bank to compensate for future conversions of wetlands during other remediation or development activities.

Alternative 4 assumes that all solid waste material and the metallic and nonmetallic surface and buried debris will be excavated. Because of the past and ongoing mission of NSF-IH, ordnance could be encountered during the excavation activities. For this reason, an MEC avoidance survey and clearing will be performed. MEC will be identified, and, if necessary, cleaned and treated before it is transported, demilitarized, and disposed. The cost estimate includes the labor costs associated with MEC excavation and disposal activities as well as the development of an after-action report. No costs were included in the alternative estimate for the treatment, transportation, demilitarization, and disposal of MEC. Excavated material would be segregated and staged onsite. Metallic debris would be recycled offsite; solid waste and contaminated soil would be disposed of in an offsite landfill as nonhazardous waste; and the excavated materials determined to be clean would be reused as backfill material in addition to the imported backfill material.

As discussed in Section 2, most of the solid waste is located below the water table; therefore, dewatering of the excavation and the materials will be required before transportation offsite. With the assumption that the thickness of the solid waste material ranges from 0 to 10 feet and the excavation area is approximately 2.8 acres, the volume of excavated solid waste/ intermingled soils/debris would be approximately 29,400 CY.

Because the solid waste and contaminated soil would be removed from the site, no ICs would be required. The post-remediation O&M activities involved would be limited to the care of the wetland until the wetland system is established. For cost estimating purposes, the O&M activities included biannual field inspections for 3 years and minor replanting. The site is assumed to achieve regulatory compliance ("closure") following one 5-year review.

Figure 4-3 depicts the conceptual design for Alternative 4.

4.1.2 Nearshore Sediment in Area B

The RAs described below apply for the nearshore sediment in Area B. This area is approximately 5,000 SF and comprises half of the nearshore sediment AA shown in Figure

2-2. The contamination in the nearshore sediment in Area A is indirectly mitigated by Alternative 2, 3, or 4 for the soil and solid waste, when it is implemented.

4.1.2.1 Alternative 1—No Action

The no-action alternative is required by the NCP and serves as the baseline alternative. All other remedial action alternatives are judged against the no-action alternative. Under this alternative, no controls or remedial technologies will be implemented. In accordance to *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000), costs associated with the 5-year reviews were not included in this alternative.

4.1.2.2 Alternative 2—Long-Term Monitoring and ICs

Alternative 2 consists of long-term chemical and biological monitoring of sediment, and implementing ICs.

Alternative 2 relies on the natural “recovery” processes to reduce sediment contamination. Many natural processes may occur in a sediment-water column system, but in general the dominant processes are:

- Biodegradation and abiotic transformations
- Sorption or other processes binding contaminants to the sediment matrix
- Burial or mixing-in-place with cleaner sediment
- Physical transport processes, such as dispersion, diffusion, and/or advection in the water column

The first two processes are preferable because they entail “treatment.” These processes are also the primary processes relied on for natural attenuation of contaminated groundwater. However, they are frequently too slow for remediating impaired sediment to achieve the RAOs within a reasonable timeframe. Therefore, isolation and mixing of contaminants through burial and physical transports are the processes most frequently relied upon for contaminated sediment (USEPA, 2005).

In conjunction with reliance on natural processes, Alternative 2 also relies on ICs in the form of waterway use restrictions, such as restricting boat traffic within the AA to establish a no-wake zone and prohibiting anchoring of vessels, as well as other activities that promote re-suspension of sediment. In addition, long-term monitoring program would be performed to assess the behavior of zinc over time.

The time frame for the isolation of the impacted sediment would likely be prolonged and hard to predict because of the complex processes and variables that affect the sediment system in the creek. For the purpose of cost estimating, the monitoring time frame (i.e., remediation time frame) would be assumed to be 30 years. If this alternative were to be implemented, further evaluation would have to be conducted to assess the rate of natural recovery processes and calculate the remediation time frame.

During the assumed 30-year time frame, zinc in sediment would be sampled quarterly for the first year, annually for the remaining years up to the first 5 years, and every 5 years thereafter for the remaining time frame up to 30 years. In addition, 5-year reviews would be performed. The frequency and time frame for the monitoring program for the nearshore sediment may be altered based on the results of the 5-year reviews. A detailed long-term monitoring plan for sediment will be developed after the ROD is signed.

4.1.2.3 Alternative 3—*In Situ* Capping and ICs

Alternative 3 consists of installing a gravel blanket over nearshore contaminated sediment in Area B. The IC components would be similar to those for sediment Alternative 2. Because the zinc-contaminated nearshore sediment will be capped in place, no long-term monitoring of zinc will be necessary under Alternative 3.

4.2 Evaluation Criteria

The detailed alternative analysis is the means for assembling and evaluating technical and policy considerations to develop the rationale for selecting a remedy. Each alternative was developed to address potential threats to human health and the environment posed by contaminated groundwater. The NCP requires RAs to be evaluated against the nine evaluation criteria listed below:

<u>Threshold Criteria</u>

- Protection of human health and the environment
- Compliance with ARARs

<u>Balancing Criteria</u>

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

<u>Modifying Criteria</u>

- State acceptance
- Community acceptance

The first two criteria are requirements that must be met unless specific ARARs are waived. The first seven criteria are discussed in this FS report. The last two criteria will be addressed in the Proposed Plan and ROD. Figure 4-4 summarizes the NCP evaluation criteria.

The following paragraphs define and detail each of the nine criteria.

4.2.1 Overall Protection of Human Health and the Environment

This evaluation criterion is an assessment of whether each alternative achieves and maintains adequate protection of human health and the environment. The overall appraisal of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Another consideration is the statutory preference for onsite remedial actions.

4.2.2 Compliance with ARARs

This evaluation criterion is used to determine whether an alternative would meet all federal, state, and local ARARs that have been previously identified. Significant ARARs are identified for each alternative, and descriptions on how they are met would be given. When an ARAR is not met, the basis for justifying one of the six waivers allowed under CERCLA would be discussed. A discussion of the compliance of each alternative with chemical-, location-, and action-specific ARARs and TBC guidance is included.

4.2.3 Long-Term Effectiveness and Permanence

Under this criterion the results of an RA are evaluated in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the actions or controls that may be required to manage the risk posed by treatment residuals or untreated wastes. Factors to be considered and addressed are magnitude of residual risk, adequacy of controls, and reliability of controls. Magnitude of residual risk is the assessment of the risk remaining from untreated waste or treatment residuals after remediation. Adequacy and reliability of controls is the evaluation of the controls that can be used to manage treatment residuals or untreated wastes that remain at the facility. The evaluation may include an assessment of containment systems and ICs to determine whether they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels, as well as the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathway and the risks posed should the remedial action need replacement.

This FS report also includes the results of the preliminary HELP model runs to assess the effectiveness of the capping alternatives in reducing infiltration into groundwater. However, because most of the waste is likely located below the water table, the percentages of water infiltration are presented for comparison only and will not be used to assess whether the alternative is effective and permanent.

4.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This evaluation criterion addresses the statutory preference for selecting remedial actions that, as their principal element, use technologies that permanently remediate and significantly reduce the toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction of contaminant mobility, or reduction of total volume of contaminated media. When evaluating this criterion, an assessment is made as to whether remediation is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either separately or in combination with one another. Factors that would be focused on include:

- Remediation processes employed by the remedy
- Amount of hazardous materials that would be remediated

- Degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction
- Degree to which the remediation would be irreversible
- Type and quantity of treatment residuals that would remain following remediation
- Whether the alternative would satisfy the statutory preference for treatment as a principal element

4.2.5 Short-Term Effectiveness

This evaluation criterion addresses the effects of an alternative during the construction and implementation phase until RAOs are met. Alternatives would be evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The following factors' RAOs would be addressed for each alternative:

- Protection of the community during remedial actions
- Protection of workers during remedial actions
- Environmental impacts during remedial actions
- Time until RAOs are achieved

4.2.6 Implementability

The implementability criterion addresses the technical and administrative feasibility of executing an alternative and the availability of various services and materials required during its implementation. Technical feasibility includes construction, operation, reliability of technology, ease of undertaking additional remedial action, and monitoring. Administrative feasibility refers to the activities needed to coordinate with other offices and agencies (e.g., local permits). Availability of services and materials includes availability of adequate off-facility treatment, storage capacity, and disposal services; necessary equipment and specialists; services and materials; and prospective technologies.

4.2.7 Cost

For the cost analysis of alternatives, the expenditures required to complete each remedial action are estimated in terms of both capital and annual O&M costs. Using these values, a present-worth calculation for each alternative can then be made for comparison.

Capital costs consist of direct and indirect costs. Direct costs include the cost of construction, equipment, land and site development, treatment, transportation, and disposal. Indirect costs include engineering expenses, license or permit costs, and contingency allowances.

Annual O&M costs are the post-construction costs required to ensure the continued effectiveness of the remedial action. Components of annual O&M cost include the cost of operating labor, maintenance materials and labor, auxiliary materials and energy, residue disposal, purchased services, administration, insurance, taxes, licensing, maintenance reserve and contingency funds, rehabilitation, monitoring, and periodic site reviews.

Expenditures that occur over a time period are analyzed using present worth, which discounts all future costs to a common base year. Present-worth analysis allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the life of the remedial project. Assumptions associated with the present-worth calculations include a discount rate of 5.2 percent[4] (Office of Management and Budget [OMB], 2005), cost estimates in the planning years in constant dollars, and a period of performance that would vary depending on the activity, but would not exceed 30 years.

All costs are within the range of -30 percent to +50 percent accuracy associated with conceptual level cost estimates for the FS, as outlined by the EPA guidance (EPA, 2000).

It should be noted that the cost estimates presented in this FS report are conceptual level costs as outlined in EPA guidance (EPA, 2000) with an expected degree of accuracy of +50 percent to -30 percent. The cost estimates were developed based on the 2004 and 2007 unit costs and on conceptual design from information available at the time of this study. Where 2004 unit costs were used, they have been adjusted with a cost escalation factor of 4 percent to reflect the projected costs in 2007/2008. The actual cost of the project would depend on the final scope and design of the selected remedial action, the schedule of implementation, competitive market conditions, and other variables. Most of these factors are not expected to affect the relative cost differences between alternatives. The cost estimates were prepared in general conformance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000).

4.2.8 State Acceptance

This assessment evaluates the technical and administrative issues and concerns that the State of Maryland may have regarding each of the alternatives. This criterion is not discussed in this report, but would be addressed in the Proposed Plan and ROD.

4.2.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As with state acceptance, this criterion is not discussed in this report, but would be addressed in the Proposed Plan and ROD.

4.3 Detailed Evaluation of RAs

This section evaluates the RAs against the seven site-specific criteria.

4.3.1 Soil, Solid Waste, and Nearshore Sediment in Area A

4.3.1.1 Alternative 1—No Action

Consideration of this alternative is required under the NCP, and serves as the baseline against which the effectiveness of other alternatives is judged. Under this alternative, no further effort or resources would be expended at Site 11 to address the solid waste or soil contamination.

[4] http://www.whitehouse.gov/omb/circulars/a094/dischist-2005.pdf.

Overall Protection of Human Health and the Environment. Implementation of Alternative 1 would not protect human health or the environment from exposures to the AAs in the soil, solid waste, and nearshore sediment in Area A. The risk posed by the landfill contents and surface soil would not be decreased because the risk of potential exposure by human and ecological receptors. Residual risks are identical to those identified in the baseline risk assessment.

Compliance with ARARs. The no-action alternative will not satisfy the chemical-specific ARARs for soil. There are no applicable location-specific ARARs for this alternative because no remedial actions will be undertaken. The alternative does not meet state regulations for solid waste landfills.

Long-Term Effectiveness and Permanence. Alternative 1 does not provide long-term effectiveness and permanence. The risk currently associated with the site would not be decreased and may be increased through continued erosion and migration of landfill contaminants to groundwater. Long-term and potential future risks posed by the site are described in the baseline risk assessment.

Reduction of Toxicity, Mobility, and Volume through Treatment. This alternative would not provide any reduction in toxicity, mobility, or volume of the landfill contents.

Short-Term Effectiveness. No immediate increased risk to the remediation workers or surrounding community would be realized by implementing this alternative. Because no action would be undertaken, the level of risk to human health and the environment is described in the baseline risk assessment.

Implementability. Evaluation of implementability includes technical feasibility, administrative feasibility, and availability of services and materials. Alternative 1 would be technically feasible because no activities would be planned.

Cost. Taking no action would require no expenditure of money for either capital or O&M investments.

4.3.1.2 Alternative 2—Protective Soil Cover, ICs, and Groundwater Monitoring and Alternative 3—RCRA Equivalent Subtitle C Cap, ICs, and Groundwater Monitoring

Because of the similar components of Alternatives 2 and 3, the detailed analyses of these alternatives are combined in this section.

Overall Protection of Human Health and Environment. Both alternatives would be protective of human health and environment. Although contaminants would remain on site, they would be prevented from entering potential exposure pathways by the presence of the soil cover or cap and ICs. The living shoreline stabilization measure provides an additional benefit to the ecological habitat by establishing the wetland. Over time, the wetland system will improve the intertidal and subtidal habitat quality. Furthermore, Alternative 2 or 3 would mitigate the nearshore sediment contamination in Area A, thereby eliminating the ecological receptor exposures to the zinc-contaminated sediment.

Compliance with ARARs. Both alternatives will comply with the location-, action-, and chemical-specific ARARs identified in Section 2. Compliance would be met through elimination of the exposure pathways. However, implementation of Alternative 2 will require a variance because of noncompliance with COMAR 26.04.07.21—Industrial Sanitary Landfill Closure requirements, a State ARAR that requires an impermeable cap to be installed for the closure of an industrial landfill, a category that was likely a best fit for the landfill at Site 11. Because most of the solid waste volume lies below the water table and the shallow groundwater is not considered to be a naturally formed aquifer and tidally influenced, reduced water infiltration would not be a critical criterion to be achieved, and therefore, soil cover is considered adequate for Site 11.

Long-Term Effectiveness and Permanence. The risks to potential human and ecological receptors from the solid waste and contaminated soil would be eliminated as long as the soil cover or cap is maintained and ICs are properly enforced. However, if items in the solid waste deteriorate or otherwise break down, contaminants may be released to the environment via a groundwater pathway. Potential releases will be detected through groundwater monitoring.

Reduction of Toxicity, Mobility, and Volume through Treatment. There would be no reduction of toxicity or volume in Alternative 2 or Alternative 3. Both alternatives reduce the potential for contact with the solid waste and contaminated soil. An impermeable cap (Alternative 3) would provide greater reduction of water infiltration through the solid waste than soil cover (Alternative 2). However, because most of the solid waste volume lies below the water table, reduced water infiltration would not be a critical criterion to be achieved, and therefore, soil cover would be considered adequate for Site 11. Although these alternatives would not meet the statutory preference for treatment, they are expected to adequately meet RAOs for this site.

Implementability. Both alternatives would be implementable. Material and services for the technologies are available.

Short-Term Effectiveness. Onsite exposure of construction workers to contaminants during placement of the soil cover or cap would be minimal. The short-term safety risks to the remediation workers from potential MEC encounters would be minimal because intrusive activities will be limited to surface clearance.

Remedial action duration would be approximately 4 to 6 months.

Cost. Alternatives 2 and 3 have approximate capital costs of $2.52 million and $3.19 million, respectively. The total lifetime O&M costs in 2007/2008 dollars are estimated at $860,000 and $947,000 for Alternatives 2 and 3, respectively. The estimated total present-worth costs are $3.01 million and $3.72 million, respectively.

Detailed costs for Alternatives 2 and 3 are presented in Appendix J.

4.3.1.3 Alternative 4—Excavation, Offsite Disposal, and Wetland Creation

Overall Protection of Human Health and the Environment. This alternative satisfies the protection of human health and environment criterion because solid waste and contaminated soil that may represent a potential source of contamination will be removed from the site, minimizing the residual contamination and therefore minimizing the potential human and ecological receptors exposures to the contaminated soil and solid waste. Similar to Alternative 2 or 3, Alternative 4 would mitigate the nearshore sediment contamination in

Area A, thereby eliminating the ecological receptor exposures to the zinc-contaminated sediment.

Compliance with ARARs. This alternative will comply with the location-, action-, and chemical-specific ARARs identified in Section 2.

Long-Term Effectiveness and Permanence. Because the potential sources of contamination will be permanently removed from the site, Alternative 4 provides excellent compliance with the long-term effectiveness and permanence. Because a new wetland would be created on the excavation area, significant benefits would be realized for the improvement of the ecological community at Site 11. Furthermore, the created wetland would contribute to the stabilization of any residual metals remaining in the soil and groundwater.

Reduction of Toxicity, Mobility, or Volume through Treatment. Alternative 4 does not reduce the toxicity, mobility, and volume of contaminants in Area A through treatment. Risks mitigation and RAOs will be achieved through the removal of the potential sources of contamination.

Short-Term Effectiveness. Under Alternative 4, RAOs would be met within 6 months to 1 year (i.e., solid waste and soil would be removed and disposed of offsite within 6 months to 1 year). Short-term impacts to the remediation workers resulting from the implementation of this alternative will be minimized through the implementation of good health and safety practices. OSHA-trained personnel will be required for all the site-related activities. Therefore, short-term hazards to the remediation workers will be minimized as much as possible. Also, erosion control measures will be used to prevent any discharge of waste from Site 11 to surface water during excavation.

Because of the past and ongoing mission of NSF-IH, ordnance could be encountered during the excavation activities. Complete removal of solid waste and contaminated soil within the AA entails an increased disadvantage because of the potential safety issues to the remediation workers.

Implementability. Excavation and landfill disposal are technically and administratively feasible because the technologies have become standard practices. Because of the potential MEC encounter, Alternative 4 may involve rigorous procedures associated with MEC avoidance, removal, treatment/demilitarization, and disposal. Another challenge is associated with effort to dewater the high volume of excavated material because 75 percent of the soil that requires excavation is in contact with the groundwater.

Cost. Alternative 4 has an approximate estimated capital cost of $9.25 million. The 30-year O&M activities would be minimal and limited to the care of the wetland for 3 years until the wetland system were to establish. The 30-year O&M costs in 2007/2008 dollars of $72,000, and a total present worth cost of $9.32 million.

It should be noted that the total present-worth cost of $7.95 million does not account for the cost associated with treatment or demilitarization of MEC. Furthermore, efforts and cost will also be expended for dewatering the excavated material because more than 75 percent of the material that requires excavation will be in contact with the groundwater.

Detailed costs for Alternative 4 are presented in Appendix J.

4.3.2 Nearshore Sediment in Area B

4.3.2.1 Alternative 1—No Action

Consideration of this alternative is required under the NCP, and serves as the baseline against which the effectiveness of other alternatives is judged. Under this alternative, no further effort or resources would be expended at Site 11 to address the impacted nearshore sediment at Site 11.

Overall Protection of Human Health and the Environment. Implementation of Alternative 1 would not protect human health or the environment. The risk posed by the impacted nearshore sediment would not be decreased because of the risk of potential exposure by human and ecological receptors. Residual risks are identical to those identified in the baseline risk assessment. Furthermore, because the metal debris posed as a continuing source of contamination would remain, the impact on the nearshore sediment would remain for a prolonged time frame.

Compliance with ARARs. The no-action alternative will not satisfy the chemical-specific ARARs for sediment. There are no applicable location-specific ARARs for this alternative because no remedial actions will be undertaken.

Long-Term Effectiveness and Permanence. Alternative 1 does not provide long-term effectiveness and permanence. The risk currently associated with the nearshore sediment would not be decreased and may be increased through continued contribution from the metal debris. Long-term and potential future risks posed by the site are described in the baseline risk assessment.

Reduction of Toxicity, Mobility, and Volume through Treatment. Alternative 1 does not reduce the toxicity, mobility, and volume of contaminated sediment through treatment. This alternative would only reduce the mobility of the contaminated sediment through the natural recovery processes. However, because the metal debris as a potential continuing source will still be in place, leaching of zinc may persist.

Short-Term Effectiveness. No immediate increased risk to the remediation workers or surrounding community would be realized by implementing this alternative. Because no action would be undertaken, the level of risk to human health and the environment is described in the baseline risk assessment. Similarly, disturbance to the existing ecological community would be minimized.

Implementability. Alternative 1 would be technically feasible because no activities would be planned.

Cost. Taking no action would require no expenditure of money for both capital and O&M investments.

4.3.2.2 Alternative 2—Long-Term Monitoring and ICs

Overall Protection of Human Health and the Environment. Under Alternative 2, the metal debris scattered along the near shoreline of Site 11 would remain in place; therefore, as indicated in the BERA report (CH2M HILL, 2005a), the debris will likely serve as the continuing source of zinc in the nearshore sediment. Alternative 2 primarily relies on the natural recovery processes, such as isolation and mixing of contaminants through burial and physical transports as mechanisms to mitigate the exposures of ecological receptors to the contaminated sediments. In addition, the ICs would provide an enforcement mechanism to minimize anthropogenic disruptions in order for the contaminated sediment to remain isolated.

Compliance with ARARs. This alternative will comply with the location-, action-, and chemical-specific ARARs identified in Section 2.

Long-Term Effectiveness and Permanence. Alternative 2 is considered effective and permanent because it would remove and control the source of contamination. The impacted sediment would return to its natural setting over time through isolation processes and continuous enforcement of ICs. Monitoring will continue as long as zinc is detected above the SRG in the sediment.

Reduction of Toxicity, Mobility, or Volume through Treatment. Reduction of toxicity, mobility, and volume of contaminants in the nearshore sediments will be achieved through natural recovery processes, which are primarily physical transports or isolation.

Short-Term Effectiveness. The existing habitat may be disturbed during the metal debris removal. However, the recovery processes would be expected to occur within a reasonable time frame (several months). However, the time frame to achieve the SRG for zinc in the nearshore sediment would be prolonged because Alternative 2 relies primarily on natural processes to isolate the impacted sediment.

Implementability. This alternative is very easy to implement and maintain. Following the removal, the metal debris would be consolidated with the soil and solid waste under the Area A cap/cover or for offsite disposal, depending on the alternative selected for the soil and solid waste for Area A and the Upland Area.

Cost. The capital cost to implement Alternative 2 is limited to developing the ICs protocol and long-term monitoring plan, which is approximately $17,400. The lifetime O&M costs in 2007/2008 dollars, assuming a lifetime of 30 years, is $120,800. The total present worth is $88,600. A detailed cost estimate is presented in Appendix J.

4.3.2.3 Alternative 3—*In Situ* Capping and ICs

Overall Protection of Human Health and Environment. Alternative 3 would be protective of human health and environment. Although contaminants would remain onsite, they would be prevented from entering potential exposure pathways by the presence of the gravel blanket and continuous enforcement of ICs.

Compliance with ARARs. Alternative 3 would comply with the location-, action-, and chemical-specific ARARs identified in Section 2. Compliance would be met through elimination of the exposure pathways.

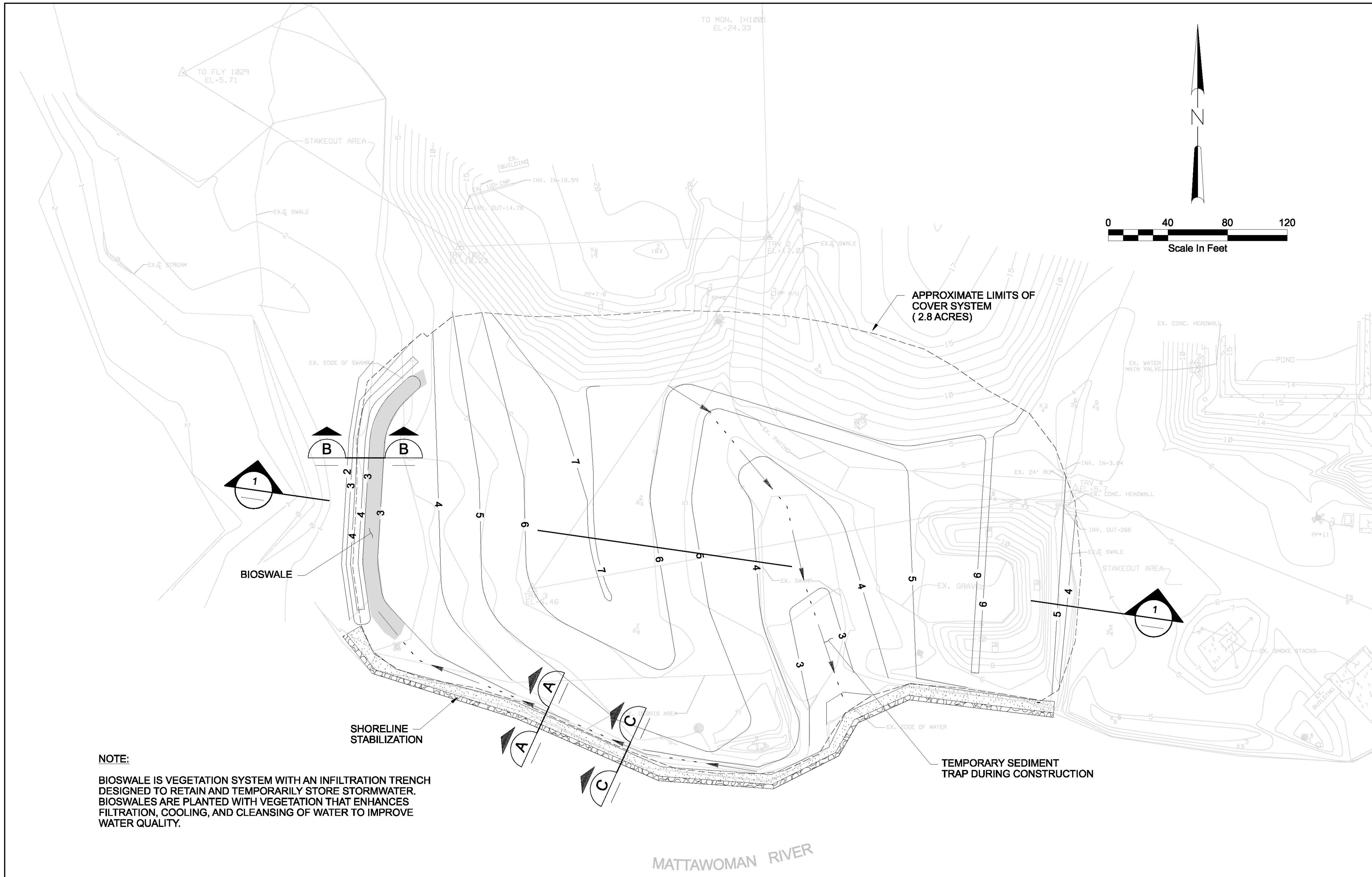
Long-term Effectiveness and Permanence. The risks to potential human and ecological receptors from the contaminated sediment would be eliminated as long as the gravel blanket is maintained and ICs are properly enforced.

Reduction of Toxicity, Mobility, and Volume through Treatment. There would be no reduction of toxicity or volume in Alternative 3. It would reduce the potential for contact with the contaminated nearshore sediment. Although Alternative 3 would not meet the statutory preference for treatment, it is expected to adequately meet RAOs for this site.

Implementability. Alternative 3 is technically and administratively implementable.

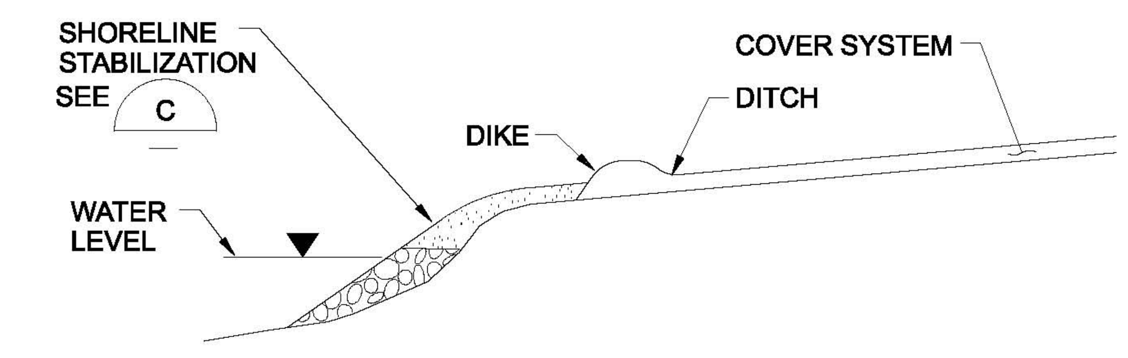
Short-Term Effectiveness. Disturbance to the existing ecological habitat would be moderate. However, the long-term benefit of the habitat recovery would outweigh the short-term disturbance. Furthermore, the RAO, and therefore the SRG, would be achieved shortly following the placement of the gravel blanket.

Cost. The capital cost for Alternative 3 is estimated at $78,800. O&M cost comprises primarily periodic costs for conducting the 5-year reviews and is approximately $54,000 in 2007/2008 dollars, assuming a lifetime of 30 years. The total present worth is $100,600. Detailed cost estimates and the present worth calculations are presented in Appendix J.



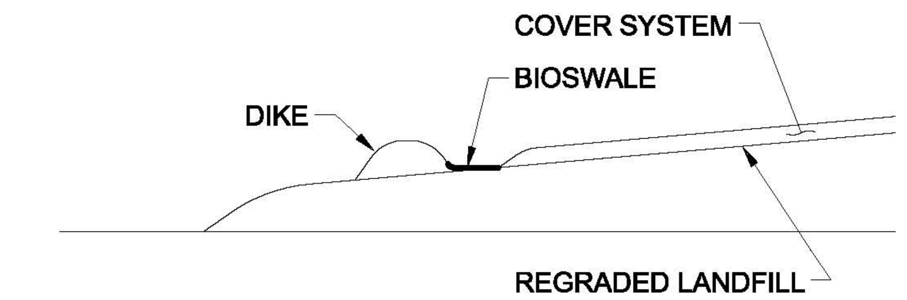
NOTE:

BIOSWALE IS VEGETATION SYSTEM WITH AN INFILTRATION TRENCH DESIGNED TO RETAIN AND TEMPORARILY STORE STORMWATER. BIOSWALES ARE PLANTED WITH VEGETATION THAT ENHANCES FILTRATION, COOLING, AND CLEANSING OF WATER TO IMPROVE WATER QUALITY.



FRONT EDGE DITCH CONCEPTUAL DETAIL (A)

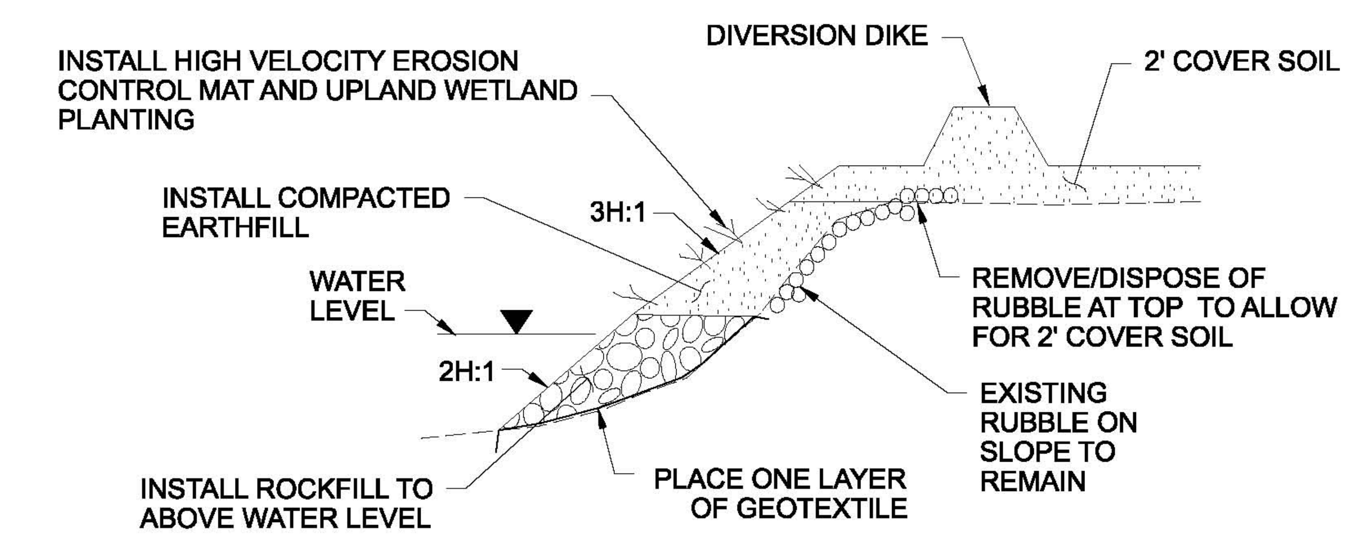
NOT TO SCALE



NOTE:
DURING CONSTRUCTION, BIOSWALE ACTS AS SEDIMENT TRAP.

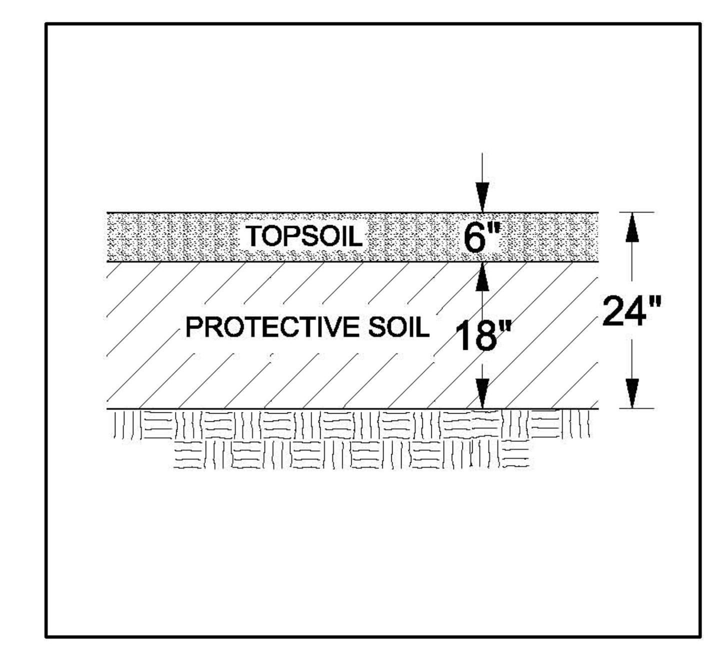
BIOSWALE CONCEPTUAL DETAIL (B)

NOT TO SCALE

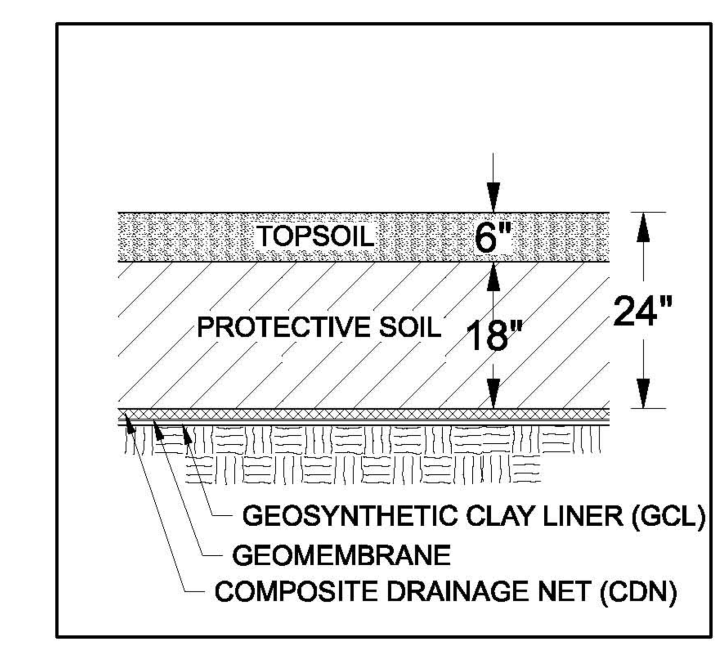


SHORELINE STABILIZATION (C)

NOT TO SCALE



ALT-2 SOIL COVER



ALT-3 RCRA C-EQUIVALENT CAP

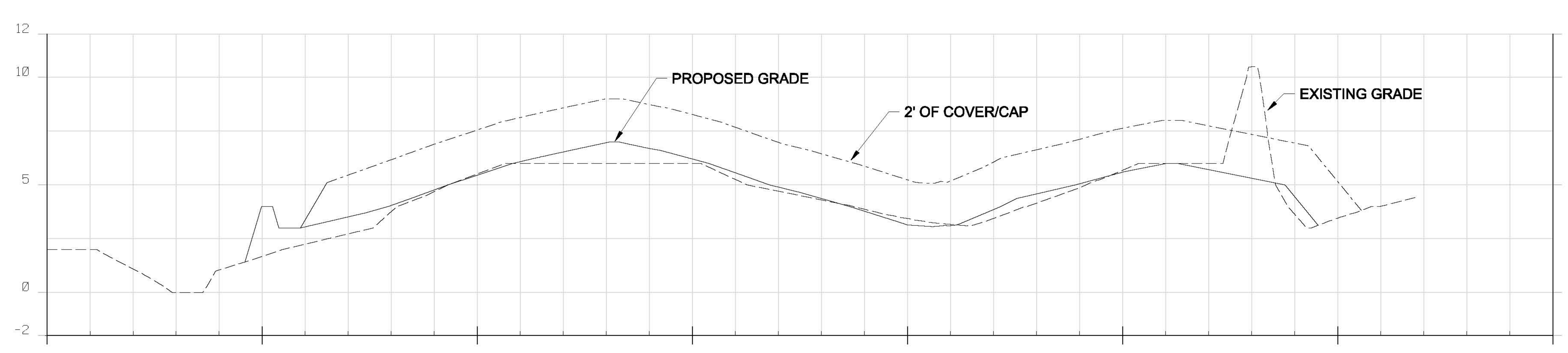
AREA

SOIL COVER/CAP = 121078 SF (2.8 ACRES)

GRADING VOLUMES

CUT VOLUME= 913 CY
FILL VOLUME = 976 CY
(TO CREATE THE BASE GRADE FOR LANDFILL COVER/CAP)

2 FEET OF COVER = 8969 CY



(1) SECTION

NTS

Figure 4-1
Conceptual Design of Alternatives 2 and 3
(Plan View)
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

CH2MHILL

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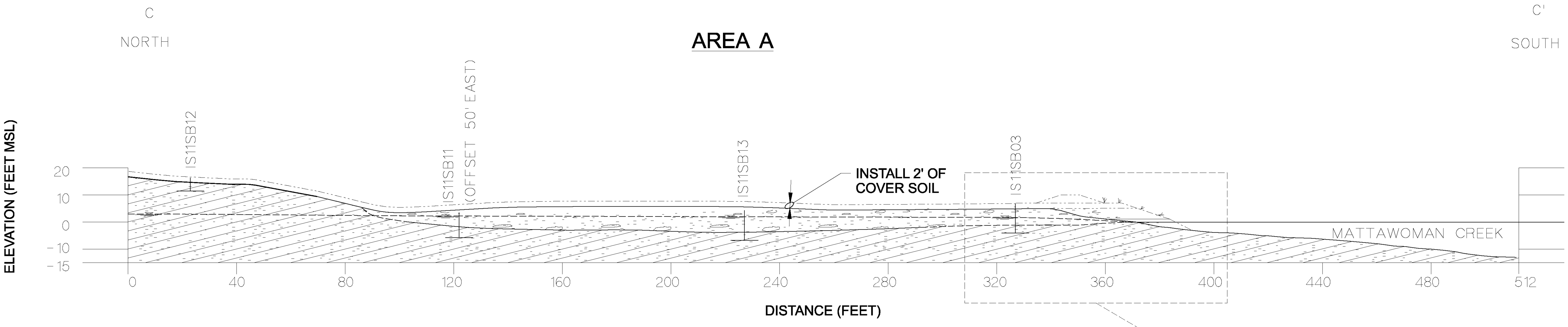
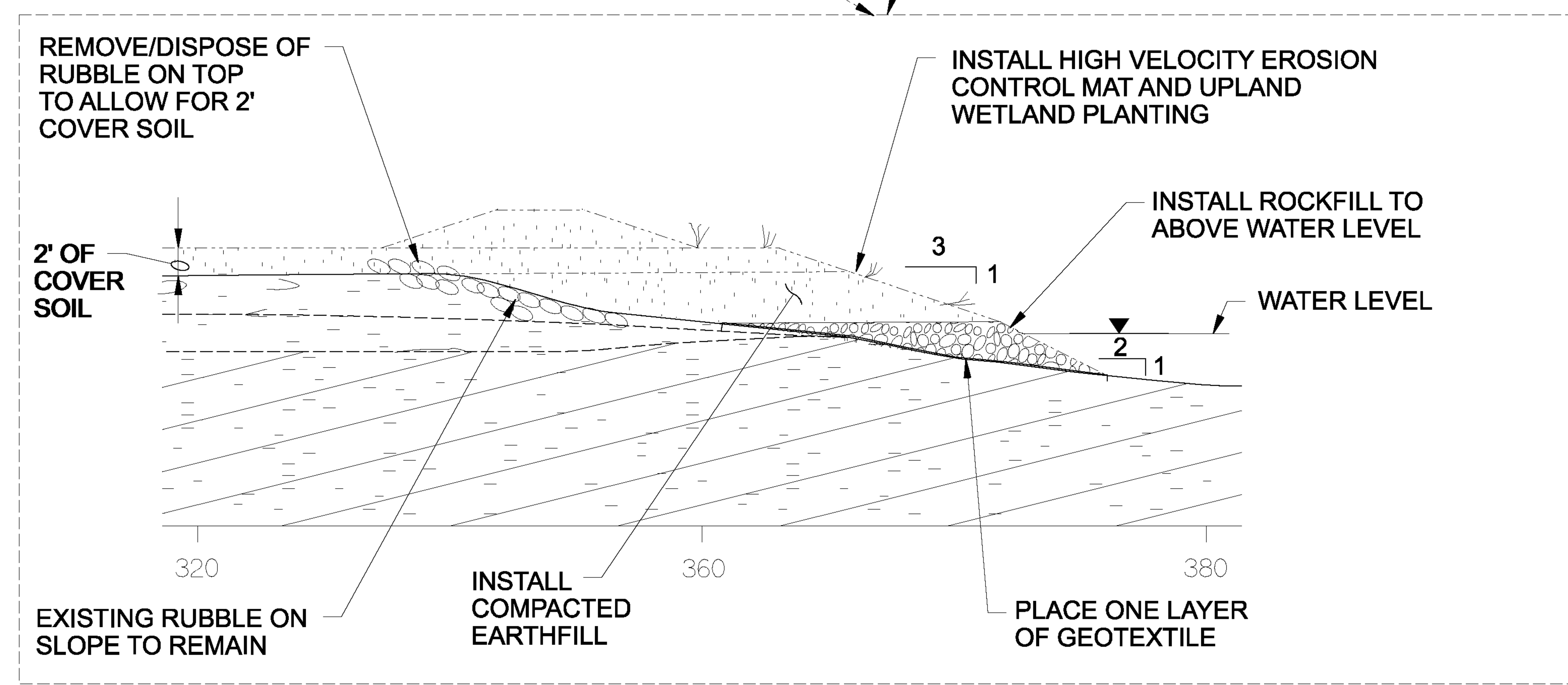
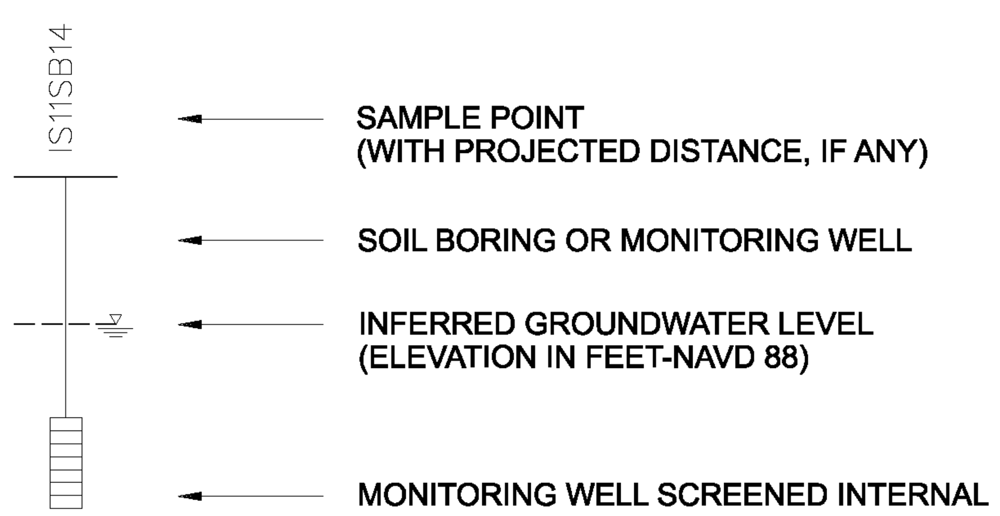
AREA A







NOTE:

1. MONITORING WELLS WERE SURVEYED BY BALDWIN AND GREGG IN DECEMBER 2000.
2. SOIL BORING LOCATIONS WERE SURVEYED WITH A GPS UNIT BY CH2M HILL; AREA A BORINGS IN 2000 AND AREA B BORINGS IN 2002
3. TOPOGRAPHIC BASE FEATURE TAKEN FROM MICRO STATION FILES SUPPLIED BY PATTON HARRIS RUST & ASSOC.,PC DATED JULY 26, 2005
4. SECTION PROFILE REPRESENTS SLOPE CONDITION AT CROSS SECTION A-A' , B-B', C-C', D-D'. SEE FIGURE 1-3 FOR LOCATION OF ALL CROSS SECTIONS.
5. LOCATION OF SUBSURFACE STRATUM BOUNDARIES HAVE BEEN INTERPOLATED FROM INFORMATION OBTAINED AT LOCATION OF BORINGS. ACTUAL CONDITION BETWEEN BORINGS MAY BE DIFFERENT THAN SHOWN ON THE CROSS SECTION. SEE APPENDIX A IN THE RI (CH2M HILL, 2004) FOR LOGS.
6. HORIZONTAL DATUM MARYLAND STATE PLANE NAD 83 AND VERTICAL DATUM NAVD 88
7. SOLID WASTE CONSISTS OF BRICK, CONCRETE, TIRE, METAL DEBRIS, SLAG, UNDIFFERENTIATED RUBBLE & DEBRIS, TREATED WOOD AND WOOD PIECES. DESCRIPTION OF THE SOLID WASTE IS TAKEN FROM THE BORING LOGS.
8. INFERRED GROUNDWATER ELEVATION BASED ON WATER LEVELS MEASURED IN MARCH 2002 POTENTIOMETRIC SURFACE ELEVATION CONTOURS (FIGURE 1-7 IN THE FS REPORT).
9. BATHYMETRIC ELEVATIONS IN MATTOWOMAN CREEK SUPPLIED BY CR ENVIRONMENTAL, DATED NOVEMBER 28, 2007. ELEVATIONS BETWEEN MEAN SEAL LEVEL AND 4 FEET BELOW SEE LEVEL ARE INTEROPOLATED.

LEGEND

STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)

EXISTING GRADE BASED ON TOPOGRAPHIC SURVEY BY PATTON HARRIS RUST & ASSOC. IN 2005

FILL-CONSISTS OF CLAY, SAND, GRAVEL, AND SOLID WASTE

NATIVE SOIL - CONSISTS OF SAND, CLAY, AND SILT

LITHOLOGY UNKNOWN; REGRADED IN 2001

0 40 80 120

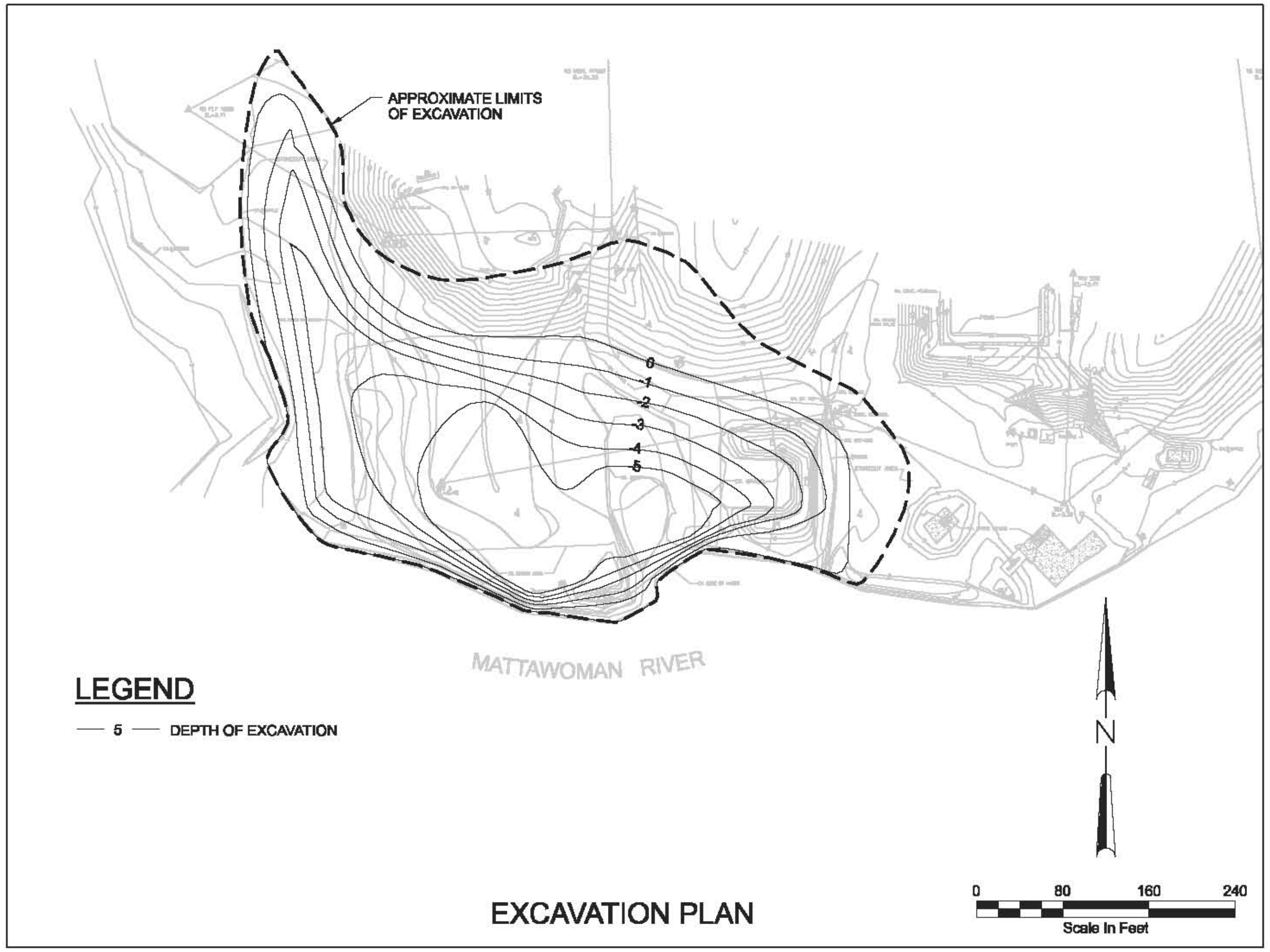
SCALE: 1"=40'

Figure 4-2
Conceptual Design of Alternative 2
(Cross-Section)

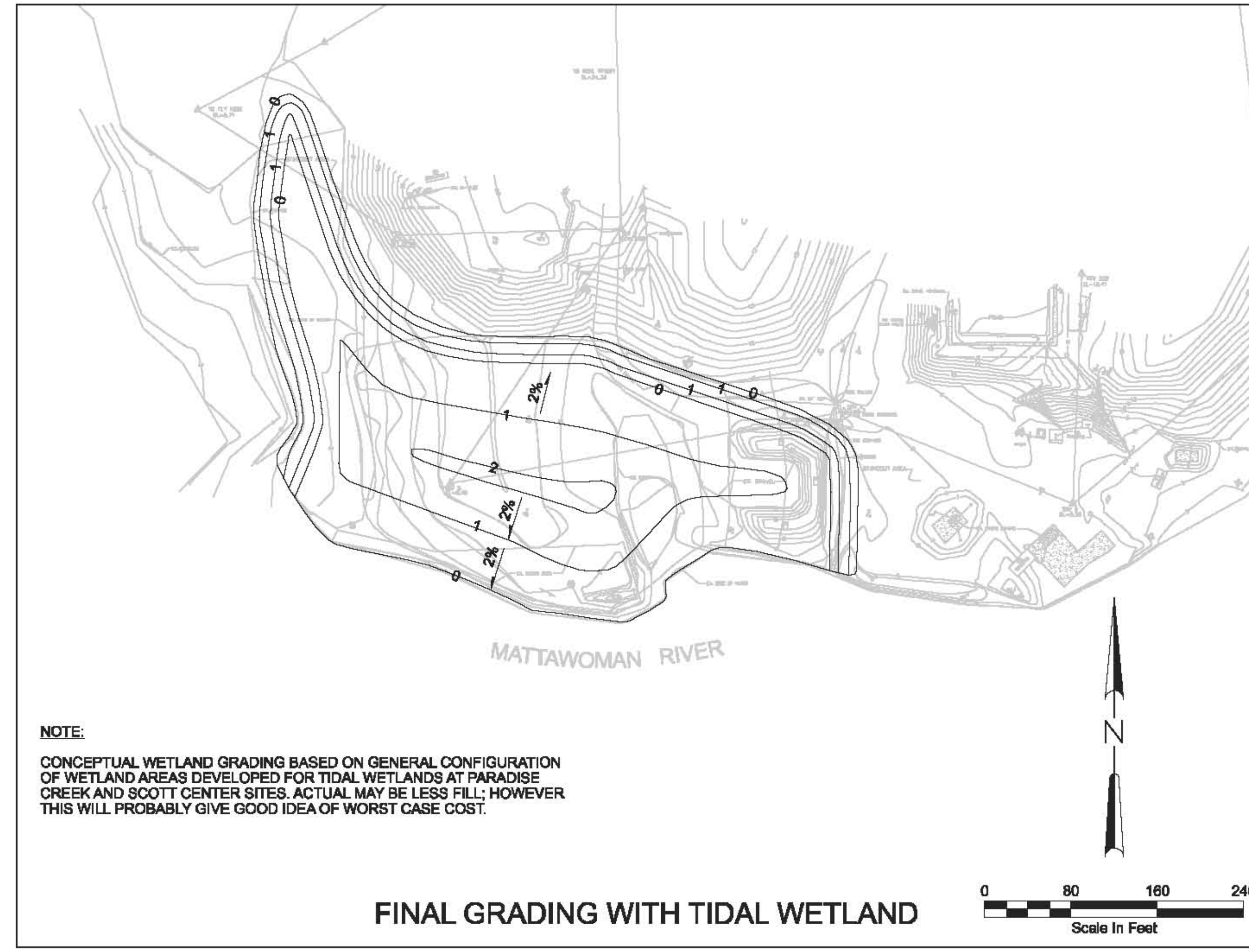
SITE 11 FEASIBILITY STUDY
NSF-IH, INDIAN HEAD, MARYLAND

CH2MHILL

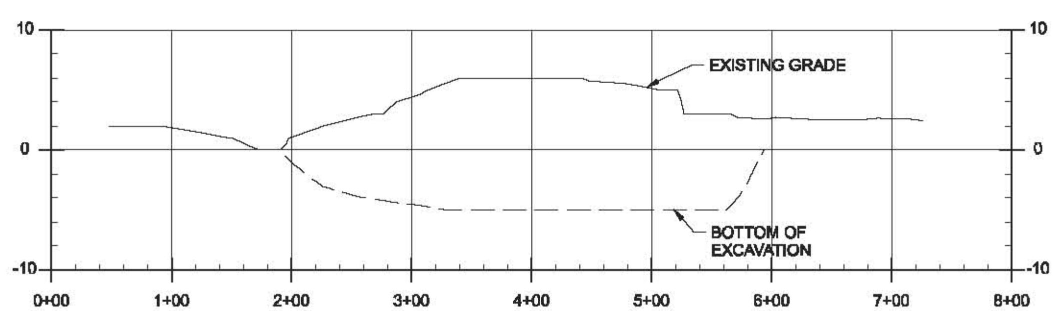
00nf100f_314138.dgn



EXCAVATION PLAN

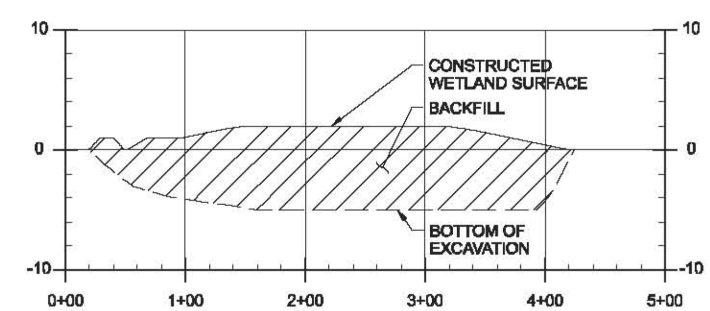


FINAL GRADING WITH TIDAL WETLAND



GRADING VOLUMES

EXCAVATION VOLUME = 26814.3 CY



GRADING VOLUMES

FILL VOLUME = 13687.7 CY

Figure 4-3
CONCEPTUAL DESIGN OF ALTERNATIVE 4
SITE 11 FEASIBILITY STUDY
NSF-IH, INDIAN HEAD, MARYLAND

CH2MHILL

00nf002f_314138.dgn

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

- How Alternatives Provide Human Health and Environmental Protection

COMPLIANCE WITH ARARs

- Compliance With Chemical-Specific ARARs
- Compliance With Action-Specific ARARs
- Compliance With Location-Specific ARARs
- Compliance With Other Criteria, Advisories, and Guidance (TBC Guidance)

LONG-TERM EFFECTIVENESS AND PERMANENCE

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT

- Treatment Process Used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility, and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Residuals Remaining After Treatment

SHORT-TERM EFFECTIVENESS

- Protection of Community During Remedial Construction
- Protection of Workers During Remedial Construction
- Environmental Impacts
- Time Until Remedial Action Objectives Are Achieved

IMPLEMENTABILITY

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Action, if Necessary
- Ability to Monitor Effectiveness of Remedy
- Ability to Obtain Approvals From Other Agencies
- Coordination With Other Agencies
- Availability of Off-site Treatment, Storage, and Disposal Services and Capacity
- Availability of Necessary Equipment, Materials, and Personnel
- Availability of Prospective Technologies

COST

- Capital Costs
- Operating and Maintenance Costs
- Present Worth Cost

STATE [(1)] ACCEPTANCE

COMMUNITY [(1)] ACCEPTANCE

1 These criteria are assessed following comment on the FS and the Proposed Plan.

FIGURE 4-4
Detailed Evaluation Criteria
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

SECTION 5

Comparative Analysis of RAs

In the following analysis, the RAs are evaluated in relation to one another for each of the seven site-specific NCP criteria. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative. Comparative analyses of RAs are documented below. Tables 5-1 and 5-2 summarize the estimated remediation costs for the soil and solid waste and the nearshore sediment, respectively.

5.1 Soil, Solid Waste, and Nearshore Sediment in Area A

5.1.1 Protection of Human Health and the Environment

All alternatives, except Alternative 1, are protective of human health and the environment. Alternative 1 does not protect human health and the environment because no action would be taken to mitigate unacceptable risk. Alternative 4 would provide the greatest measure of protection because the contaminated media would be removed from the site. The protection afforded by Alternatives 2 and 3 was considered comparable. Even though Alternative 3 affords a greater mechanism for water infiltration reduction, the benefit to groundwater is considered marginal because most of the waste already lies under the water table and, in its current condition, groundwater quality at Site 11 is considered acceptable and not posing presumably unacceptable risks to human health and the environment.

5.1.2 Compliance with ARARs

All alternatives, except Alternatives 1 and 2, would fully comply with the ARARs and TBCs. Alternative 1 does not satisfy most of the ARARs and TBCs. Alternative 2 would fully comply with all ARARs and TBCs, with the exception of COMAR 26.04.07.21. Therefore, implementation of Alternative 2 will require a waiver because of the noncompliance with COMAR 26.04.07.21—Industrial Sanitary Landfill Closure requirements, a State ARAR that requires an impermeable cap to be installed for the closure of an industrial landfill, a category that was likely a best fit for the landfill at Site 11. Unlike Alternative 4, the compliance with ARARs and TBCs under Alternatives 2 and 3 depends on the continuous enforcement of the ICs and maintenance of the cover's or cap's integrity, as well as groundwater monitoring.

5.1.3 Long-Term Effectiveness and Permanence

All alternatives, with the exception of Alternative 1, will achieve long-term effectiveness and permanence. Alternative 4, however, would achieve the greatest reduction of residual risk and the greatest adequacy and reliability of controls because contaminated media would be removed from the site. Alternatives 2 and 3 are effective and permanent only to the extent that the cap or cover is maintained; these alternatives require continued maintenance to preserve risk reduction.

5.1.4 Reduction in Toxicity, Mobility, and Volume through Treatment

None of the alternatives would reduce the toxicity, mobility, or volume of contaminants through treatment. However, Alternative 4 would afford the greatest extent of mobility reduction by removing and disposing of them in an appropriately designed and permitted facility. Similarly, because of the removal of the contaminated media, Alternative 4 would leave a minimal quantity of residuals after removal and backfill. Because of the created wetland, Alternative 4 would also afford a polishing treatment of residual metals in water prior to its discharge to the Creek. Because neither treatment nor removal would be associated with Alternatives 1 through 3, these alternatives provide no reduction in the quantity of residuals.

5.1.5 Short-Term Effectiveness

Alternative 1 implies no short-term risks to the remediation workers because no activities would be planned under this alternative. The short-term risks associated with the construction activities under Alternatives 2 through 4 would be minimized by implementing appropriate health and safety procedures, although the safety risks to the remediation workers associated with the potential presence of MEC would be the highest under Alternative 4 because of the scale of the excavation activities.

Short-term disruptions to the local community and the day-to-day installation operations may be experienced from the heavy equipment operations, such as increased traffic of construction trucks in and out of the site and dust generation from the heavy equipment during regrading, excavation, or backfill operations. However, these disruptions would be minimized through a proper planning for traffic diversion and periodic dust suppression.

The RAOs, and thus the SRGs, under all alternatives except Alternative 1, would be achieved as soon as construction activities were completed, within 6 months to 1 year. Although under Alternative 4, the created wetland may not be fully established within 1 year.

5.1.6 Implementability

All alternatives involving active remedies would be readily implementable because the technologies contained in these alternatives are all well-accepted and conventional treatments, and they have been used successfully at numerous other NPL sites. Alternatives 2 and 3 might require approvals from more state agencies than Alternative 4, given state guidance and regulations on landfill cover design. A state variance will be required for implementation of Alternative 2 because an impermeable cap is required for a closure cap of an industrial sanitary landfill, a category that best fitted the landfill at Site 11. Alternative 4 requires identifying an appropriate disposal facility with sufficient capacity for this waste stream. Furthermore, treatment or demilitarization of MEC may be required under Alternative 4.

5.1.7 Cost

As shown in Table 5-1, with the exception of Alternative 1, Alternative 2 is considered the most cost-efficient alternative, followed by Alternatives 3 and 4.

All costs are within the degree of -30 percent to +50 percent accuracy associated with conceptual level cost estimates for the FS, as outlined by the USEPA guidance (USEPA, 2000).

5.2 Nearshore Sediment in Area B

5.2.1 Protection of Human Health and the Environment

All alternatives, with the exception of Alternative 1, are protective of human health and the environment. Alternative 1 does not protect human health and the environment because no action would be taken to mitigate unacceptable risk.

Alternative 3 would provide the greatest measure of protection because the contaminated sediment would be capped, minimizing or eliminating exposure to the ecological receptors. Alternative 2 is considered adequately protective to human health and the environment. Because surface runoff would be mitigated by the soil and solid waste remediation, the residual risks associated with the nearshore sediment would ultimately decrease over time through the ongoing natural recovery processes. The impacted sediment would remain isolated as a result of these processes and a continuous implementation of ICs. Alternative 2 also takes into account a mechanism to evaluate zinc concentrations over time through a long-term monitoring program for the sediment. If concentrations of zinc were found to pose unacceptable risks to the ecological receptors, other approaches would be evaluated.

5.2.2 Compliance with ARARs

Both Alternatives 2 and 3 would comply with the ARARs and TBCs. However, unlike Alternative 3, the compliance with ARARs and TBCs under Alternative 2 depends on favorable natural processes or events that maintain the impacted sediment being isolated and the continuous enforcement of the ICs to eliminate anthropogenic activities to prevent re-suspension of the isolated sediment.

Alternative 1 will not comply with the chemical-specific ARARs (i.e., SRG) because the source of contamination would remain in place.

5.2.3 Long-Term Effectiveness and Permanence

Alternatives 2 and 3 will achieve long-term effectiveness and permanence. Alternative 3, however, would achieve the greatest reduction of residual risk and the greatest adequacy and reliability of controls because the source of contamination and the contaminated media would be capped, minimizing the exposure to ecological receptors immediately after the cap is in place. Alternative 2 is permanent only to the extent that the contaminated sediment remains isolated; however, the contaminated sediment isolation relies on slow and unverified processes of natural recovery.

5.2.4 Reduction in Toxicity, Mobility, and Volume through Treatment

None of the alternatives would reduce the toxicity, mobility, or volume of contaminants through treatment.

Alternative 3 relies on reduction in the mobility of zinc through capping as well as the natural recovery processes over time. Under Alternative 2, the reduction in the mobility of the contaminated sediment would rely on natural processes by isolation. The timeframe for isolating the affected sediment would likely be prolonged and hard to predict because of the complex processes and variables that affect the sediment system in the creek.

5.2.5 Short-Term Effectiveness

Alternatives 1 and 2 would cause no impacts to either remediation workers or the current intertidal sediment habitat because no construction activities are planned. Alternative 3 would generate a short-term disturbance to the existing intertidal sediment habitat during the installation of the cap. Impacts to remediation workers would be minimal or potentially nonexistent.

Alternative 1 is incapable of achieving the RAOs because both the contamination source (i.e., metal debris) and the contaminated sediment would remain onsite. Achievement of sediment RAOs under Alternative 2 would be less certain than Alternative 3, primarily because the contaminated sediment would remain onsite, relying solely on natural processes and favorable natural events to isolate the affected sediment. Under Alternative 3, RAOs will be achieved following the capping; however, the intertidal sediment habitat would not be immediately reestablished following the removal action.

5.2.6 Implementability

Both alternatives involving active remedies would be technically implementable because the technologies contained in these alternatives are all well-accepted, conventional, and have been used successfully at other NPL sites.

In terms of administrative implementability, Alternatives 2 and 3 would require a long-term commitment of administrative resources to enforce continuous implementation of ICs and long-term sediment monitoring.

5.2.7 Cost

As shown in Table 5-2, with the exception Alternative 1, Alternative 2 is considered the most cost-efficient alternative, followed by Alternative 3.

TABLE 5-1
Cost Summary for Soil and Solid Waste Remedial Alternatives
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Alternative	Estimated Capital Cost	Estimated Present Worth O&M Cost	Estimated Present Worth Cost
1 – No Action	$0	$0	$0
2 – Soil Cover, Groundwater Monitoring, and ICs	$2,524,300	$488,500	$3,012,800
3 – RCRA C Equivalent Cap, Groundwater Monitoring, and ICs	$3,191,400	$532,900	$3,724,300
4 – Excavation, Off-site Disposal, and Wetland Creation	$9,256,400	$63,200	$9,319,500

Note: Cost accuracy ranges from -30 percent to +50 percent

TABLE 5-2
Cost Summary for Sediment Remedial Alternatives
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Alternative	Estimated Capital Cost	Estimated Present Worth O&M Cost	Estimated Present Worth Cost
1 – No Action	$0	$0	$0
2 – Long-Term Monitoring, and ICs	$17,400	$71,300	$88,600
3 – In Situ Capping and ICs	$78,800	$21,900	$100,600

Note: Cost accuracy ranges from -30 percent to +50 percent

SECTION 6
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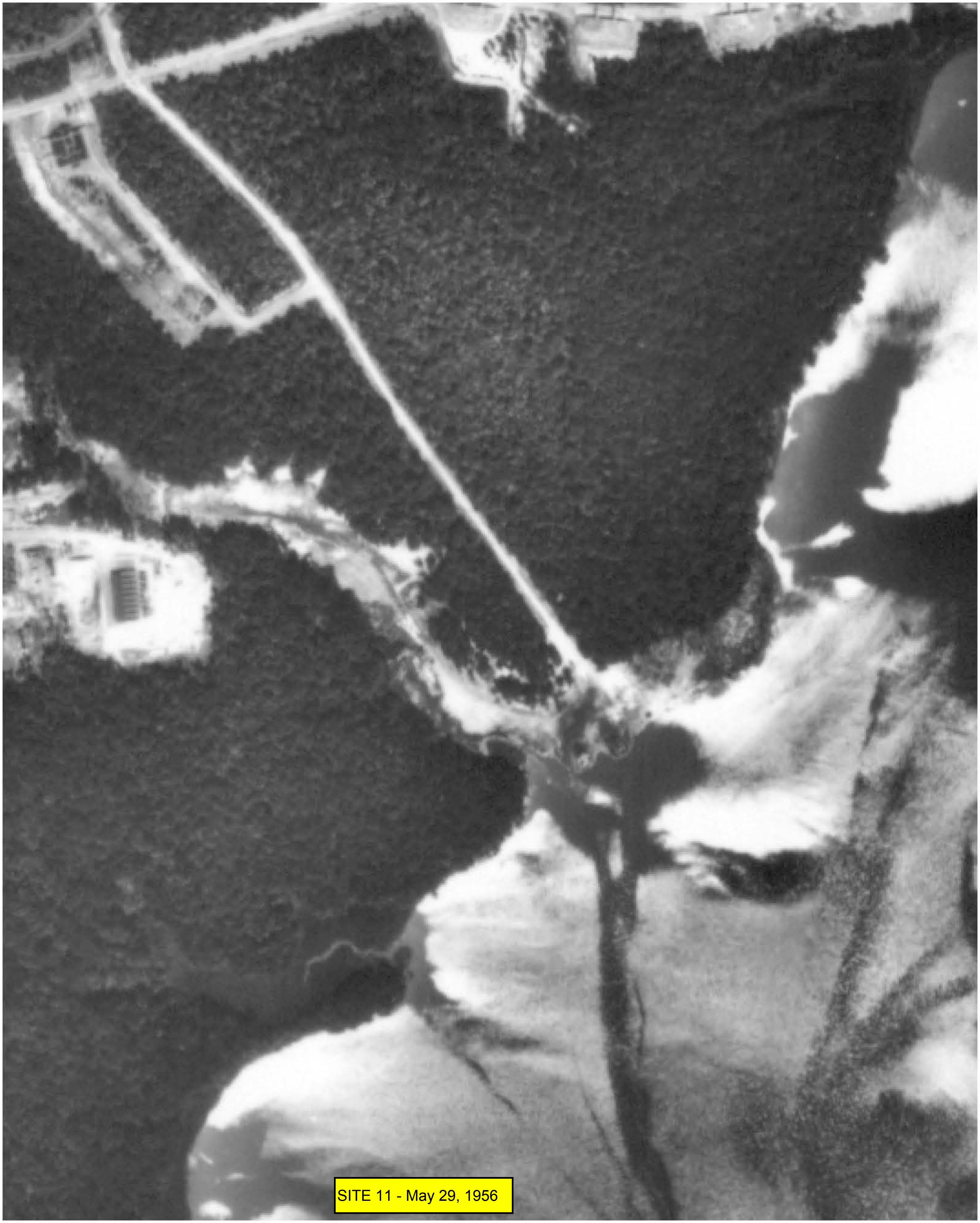
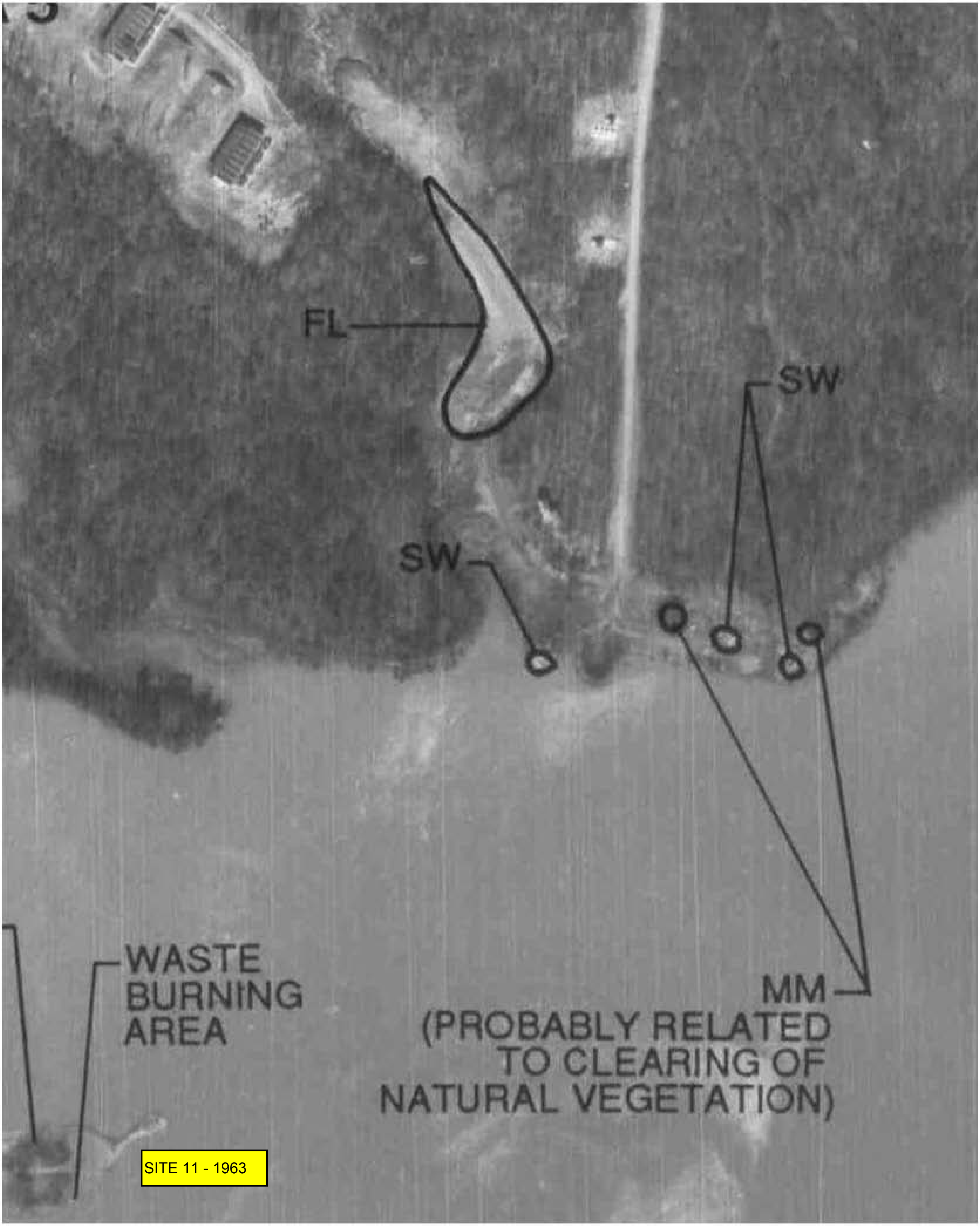
Appendix A
Aerial Photographs



SITE 11 - May 29, 1956


FL
SW
SW
WASTE BURNING AREA
MM (PROBABLY RELATED TO CLEARING OF NATURAL VEGETATION)
SITE 11 - 1963


SITE 11 - September 15, 1967


SITE 11 - April 18, 1972


SITE 11 - May 6, 1980

Appendix B
Complete Analytical Results

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO06	IS11SO10	IS11SO13	IS11SO14	IS11SO15	IS11SO16	IS11SO17	IS11SO18	IS11SO19	IS11SO20	IS11SO21	IS11SO22	IS11SO23
Sample ID	IS11SS060001	IS11SS100001	IS11SS130001	IS11SS140001	IS11SS150001	IS11SS160001	IS11SS170001	IS11SS180001	IS11SS190001	IS11SS200001	IS11SS210001	IS11SS220001	IS11SS230001
Sample Date	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00
Chemical Name													
Volatile Organic Compounds (UG/KG)													
1,1,1-Trichloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
1,1,2,2-Tetrachloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
1,1,2-Trichloro-1,2,2- trifluoroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
1,1,2-Trichloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
1,1-Dichloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
1,1-Dichloroethene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
1,2,4-Trichlorobenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
1,2-Dibromo-3-chloropropane	13 R	18 R	13 U	13 U	13 R	11 R	16 U	64 R	18 R	13 R	12 R	11 R	12 R
1,2-Dibromoethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
1,2-Dichlorobenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
1,2-Dichloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
1,3-Dichlorobenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
1,4-Dichlorobenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
2-Butanone	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
2-Hexanone	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
4-Methyl-2-pentanone	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Acetone	13 U	18 UJ	3.6 B	3 B	13 U	1.2 B	2.7 B	27 B	18 U	1.9 B	2.2 B	11 U	12 U
Benzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Bromodichloromethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Bromoform	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Bromomethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Carbon disulfide	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Carbon tetrachloride	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Chlorobenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Chloroethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Chloroform	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Chloromethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Cumene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Cyclohexane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Dibromochloromethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Dichlorodifluoromethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Ethylbenzene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Methyl acetate	1.7 J	4.2 J	13 U	1.6 J	13 U	11 U	16 U	24 J	2.9	13 U	12 U	11 U	12 U
Methyl-tert-butyl ether (MTBE)	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Methylcyclohexane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Methylene chloride	13 U	2.1 B	13 U	1.5 B	1.6 B	1.2 B	1.8 B	64 U	2.4 B	13 U	12 U	11 U	1.9 B
Styrene	13 U	18 UJ	13 U	13 U	13 U	11 U	32 J	23 J	18 UJ	13 U	12 UJ	11 U	12 U
TPH-gas range	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Toluene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
Trichloroethene	13 U	3.9 J	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
Trichlorofluoromethane	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Vinyl chloride	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
Xylene, total	13 U	18 UJ	13 U	13 U	13 U	11 U	16 UJ	64 U	18 UJ	13 U	12 UJ	11 U	12 U
cis-1,2-Dichloroethene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
cis-1,3-Dichloropropene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 UJ	11 U	12 U
trans-1,2-Dichloroethene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U
trans-1,3-Dichloropropene	13 U	18 UJ	13 U	13 U	13 U	11 U	16 U	64 U	18 U	13 U	12 U	11 U	12 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO06	IS11SO10	IS11SO13	IS11SO14	IS11SO15	IS11SO16	IS11SO17	IS11SO18	IS11SO19	IS11SO20	IS11SO21	IS11SO22	IS11SO23
Sample ID	IS11SS060001	IS11SS100001	IS11SS130001	IS11SS140001	IS11SS150001	IS11SS160001	IS11SS170001	IS11SS180001	IS11SS190001	IS11SS200001	IS11SS210001	IS11SS220001	IS11SS230001
Sample Date	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00
Chemical Name													
Semi-volatile Organic Compounds (UG/KG)													
1,1-Biphenyl	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2,2'-Oxybis(1-chloropropane)	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2,4,5-Trichlorophenol	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
2,4,6-Trichlorophenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2,4-Dichlorophenol	430 U	1,200 U	420 R	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2,4-Dimethylphenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2,4-Dinitrophenol	1,100 R	3,000 R	1,000 U	1,100 R	1,100 R	930 R	1,300 R	1,100 R	1,500 R	1,100 R	1,000 R	930 R	1,000 R
2-Chloronaphthalene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2-Chlorophenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2-Methylnaphthalene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	50 J
2-Methylphenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
2-Nitroaniline	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
2-Nitrophenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
3,3'-Dichlorobenzidine	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
3-Nitroaniline	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
4,6-Dinitro-2-methylphenol	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
4-Bromophenyl-phenylether	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
4-Chloro-3-methylphenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
4-Chloroaniline	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
4-Chlorophenyl-phenylether	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
4-Methylphenol	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
4-Nitroaniline	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
4-Nitrophenol	1,100 U	3,000 U	1,000 U	1,100 U	1,100 U	930 U	1,300 U	1,100 U	1,500 U	1,100 U	1,000 U	930 U	1,000 U
4-Nitrotoluene	250 U	250 U	250 U	250	250 U	250 U	250 U	120 J	250 U	250 U	250 U	250 U	250 U
Acenaphthene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	78 J
Acenaphthylene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Acetophenone	90 J	1,200 U	620	760	180 J	81 J	570	180 J	190 J	420 U	710	130 J	160 J
Anthracene	430 U	660 J	420 U	430 U	430 U	370 U	530 U	420 U	580 U	48 J	400 U	54 J	180 J
Atrazine	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Benzaldehyde	430 U	1,200 U	250 J	320 J	340 J	370 U	260 J	99 J	110 J	420 U	370 J	370 U	110 J
Benzo(a)anthracene	85 J	3,300	420 U	430 U	110 J	370 U	530 U	420 U	330 J	200 J	120 J	450	720
Benzo(a)pyrene	430 U	510 J	420 U	430 U	430 U	370 U	530 U	420 U	81 J	420 U	400 U	79 J	150 J
Benzo(b)fluoranthene	260 J	4,000	420 U	430 U	180 J	370 U	530 U	420 U	560 J	430	440	750	940
Benzo(g,h,i)perylene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Benzo(k)fluoranthene	86 J	2,200	420 U	430 U	430 U	370 U	530 U	420 U	250 J	170 J	150 J	260 J	380 J
Butylbenzylphthalate	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	96 J
Caprolactam	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Carbazole	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	85 J
Chrysene	210 J	3,500	420 U	430 U	130 J	370 U	530 U	420 U	390 J	320 J	240 J	530	760
Di-n-butylphthalate	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	290 J	100 J
Di-n-octylphthalate	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Dibenz(a,h)anthracene	430 U	530 J	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	120 J
Dibenzofuran	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	65 J
Diethylphthalate	45 J	1,200 U	420 U	430 U	430 U	160 J	530 U	420 U	150 J	420 U	400 U	370 U	69 J
Dimethyl phthalate	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Fluoranthene	300 J	6,800	420 U	430 U	180 J	370 U	530 U	420 U	530 J	590	210 J	750	1,500
Fluorene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	120 J
Hexachlorobenzene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Hexachlorobutadiene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Hexachlorocyclopentadiene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Hexachloroethane	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Indeno(1,2,3-cd)pyrene	49 J	640 J	420 U	430 U	430 U	370 U	530 U	420 U	100 J	73 J	70 J	120 J	180 J
Isophorone	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Naphthalene	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	65 J
Pentachlorophenol	1,000 U	2,900 U	1,000 U	1,100 U	1,000 U	900 U	1,300 U	1,000 U	1,400 U	1,000 U	980 U	900 U	980 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO06	IS11SO10	IS11SO13	IS11SO14	IS11SO15	IS11SO16	IS11SO17	IS11SO18	IS11SO19	IS11SO20	IS11SO21	IS11SO22	IS11SO23
Sample ID	IS11SS060001	IS11SS100001	IS11SS130001	IS11SS140001	IS11SS150001	IS11SS160001	IS11SS170001	IS11SS180001	IS11SS190001	IS11SS200001	IS11SS210001	IS11SS220001	IS11SS230001
Sample Date	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00
Chemical Name													
Phenanthrene	86 J	3,100	420 U	430 U	110 J	370 U	530 U	420 U	180 J	230 J	400 U	290 J	1,000
Phenol	430 U	1,200 U	120 J	430 U	430 U	370 U	530 U	420 U	580 U	420 U	160 J	370 U	400 U
Pyrene	170 J	2,400	420 U	430 U	430 U	370 U	530 U	420 U	250 J	200 B	150 J	310 J	610
bis(2-Chloroethoxy)methane	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
bis(2-Chloroethyl)ether	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
bis(2-Ethylhexyl)phthalate	430 U	240 J	420 U	430 U	130 J	370 U	530 U	420 U	580 U	1,800	400 U	250 J	360 J
n-Nitroso-di-n-propylamine	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
n-Nitrosodiphenylamine	430 U	1,200 U	420 U	430 U	430 U	370 U	530 U	420 U	580 U	420 U	400 U	370 U	400 U
Explosives (UG/KG)													
1,3,5-Trinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-Trinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-Dinitrotoluene	250 U	150 J	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
3-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonium perchlorate	110 U	130 U	91 U	110 U	100 U	100 U	130 U	110 U	110 U	100 U	110 U	100 U	100 U
HMX	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	220 J
Nitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Nitroglycerin	1,300 U	1,600 U	1,100 U	1,200 U	1,200 U	1,300 U	1,400 U	1,300 U	1,400 U	1,300 U	1,200 U	1,100 U	1,300 U
Nitroguanidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PETN	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
RDX	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	210 J	500 U	500 U	500 U
Tetryl	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U
Total Metals (MG/KG)													
Aluminum	2,410	6,270	2,560	4,580	5,040	8,070	8,730	6,810	7,490	5,320	4,480	4,740	15,100
Antimony	1.1 UL	3.2 UL	1.1 U	1.1 U	14.6 L	5.2 L	18.9 L	1.1 UL	3.1 L	1.5 L	1.1 UL	4.3 L	8.4 L
Arsenic	2.6 L	26.2	7.1	1.9 L	8.9	5.4	9.4	5.3	13	6.1	4 L	8.1 L	21.8
Barium	21.5 J	129	15.9 J	21.6 J	268	367	201	64.9	152	58.2	71.6	70.6	202
Beryllium	0.052 U	0.21 B	0.11 J	0.09 B	0.086 B	0.17 B	0.48 B	0.52 B	0.39 B	0.2 B	0.23 B	0.045 U	0.079 B
Cadmium	1.3 J	39.9	0.21 J	0.15 J	8.7	1.4	8.6	1 J	18.4	5.3	0.6 J	23.7	79.4
Calcium	894 J	4,900 J	212 J	325 J	3,060 J	3,910 J	1,500 J	409 J	4,010 J	983 J	130 B	6,610 J	5,820 J
Chromium	5.4	24.1	8.5	5.9	28.6	21	22.7	12.2	26.1	12	6.5	28.7	112
Cobalt	28.2 L	15 L	2.6 J	2.6 L	16.5	5.1 L	17	17.6	6.7 L	6.1 L	4.4 L	4.7 L	9.4 L
Copper	20.5	520	19	4.7 J	427	337	89.8	16.8	218	44.9	12.1	249	1,400
Cyanide	0.12 B	0.92 U	0.2 B	0.11 B	0.75 B	0.65 B	0.16 B	0.14 B	0.48 B	0.21 B	0.11 B	0.19 B	0.27 B
Iron	6,500	263,000	5,770	5,930	37,100	18,300	10,100	13,800	29,300	10,400	7,210	23,300	78,500
Lead	64.8	976	93.5	19.4	1,060	849	6,010	451	501	97	61.6	132,000	1,300
Magnesium	363 J	1,190 J	188 J	341 J	727 J	1,000 J	749 J	776 J	1,210 J	559 J	260 J	2,210	2,810
Manganese	240	1,330	28.7	21.9	506	167	325	362	281	185	29.1	192	465
Mercury	0.22 L	0.3 L	0.26 L	0.066 UL	42 L	3.1 L	1.6 L	0.33 L	0.68 L	0.45 L	0.2 L	0.97 L	1.2 L
Nickel	5.2 J	30.7	3.5 J	4.5 J	189	17.4	19.8	10.5	26.2	9.4 J	5.8 J	36	63.9
Potassium	170 J	447 J	207 J	284 J	407 J	877 J	685 J	551 J	694 J	382 J	309 J	390 J	932 J
Selenium	1.1 UL	3.2 UL	1.1 UL	1.1 UL	1.1 UL	0.96 UL	1.4 UL	1.1 UL	1.5 UL	1.1 UL	1.1 UL	0.97 UL	1.1 UL
Silver	0.8 UL	1.6 L	0.8 J	0.82 U	22.3	10	15	1.5 J	17	3.3 L	1.4 L	9.1	20.2
Sodium	113 U	655 J	111 U	116 UL	115 U	167 J	142 U	113 U	154 U	112 U	107 U	120 J	593 J
Thallium	1.4 U	3.9 U	1.3 U	1.4 U	1.4 U	1.2 U	1.7 U	1.4 U	1.9 U	1.4 U	1.3 U	5.5	1.3 J
Vanadium	8.9 J	33.3 J	16.1	13.5	26.3	20.2	21.2	24.6	27.5	22	22.5	15.4	27.9
Zinc	101 J	10,000 J	30.2 J	22.3 J	1,150 J	697 J	923 J	116 J	755 J	232 J	32.8 J	901 J	4,210 J

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO06	IS11SO10	IS11SO13	IS11SO14	IS11SO15	IS11SO16	IS11SO17	IS11SO18	IS11SO19	IS11SO20	IS11SO21	IS11SO22	IS11SO23
Sample ID	IS11SS060001	IS11SS100001	IS11SS130001	IS11SS140001	IS11SS150001	IS11SS160001	IS11SS170001	IS11SS180001	IS11SS190001	IS11SS200001	IS11SS210001	IS11SS220001	IS11SS230001
Sample Date	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00	07/18/00
Chemical Name													
Wet Chemistry (MG/KG)													
% Moisture	22.5	45.4	20.5	24	23.5	10.7	38.2	21.9	43	21.6	18	10.9	18.4
% Solids	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (MG/KG)													
TPH-diesel range	9.4	80	18	54	310	8.8	65	82	74	90	34	33	94
TPH-gas range	0.13 U	0.18 U	0.13 U	0.13 U	0.13 U	0.11 U	0.34	3.9	0.24	0.13 U	0.12 U	0.11 U	0.12 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO24		IS11SO25	IS11SO26	IS11SO27		IS11SO28	IS11SO29	IS11SO30	IS11SO31	IS11SO32	IS11SO33		IS11SO34	IS11SO35
Sample ID	IS11SS240001	IS11SS240001P	IS11SS250001	IS11SS260001	IS11SS270001	IS11SS270001P	IS11SS280001	IS11SS290001	IS11SS300001	IS11SS310001	IS11SS320001	IS11SS330001	IS11SS330001P	IS11SS340001	IS11SS350001
Sample Date	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00
Chemical Name															
Volatile Organic Compounds (UG/KG)															
1,1,1-Trichloroethane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
1,1,2,2-Tetrachloroethane	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,1,2-Trichloro-1,2,2- trifluoroethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
1,1,2-Trichloroethane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
1,1-Dichloroethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
1,1-Dichloroethene	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
1,2,4-Trichlorobenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,2-Dibromo-3-chloropropane	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,2-Dibromoethane	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,2-Dichlorobenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,2-Dichloroethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
1,2-Dichloroethene (total)	14 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
1,3-Dichlorobenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
1,4-Dichlorobenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
2-Butanone	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	21 B	18 UJ
2-Hexanone	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
4-Methyl-2-pentanone	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Acetone	2 B	14 U	18 U	1.6 B	12 U	1.4 B	12 U	13 UJ	1.6 B	23 J	13 U	13 U	16 UJ	65 J	18 UJ
Benzene	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Bromodichloromethane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Bromoform	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Bromomethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Carbon disulfide	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Carbon tetrachloride	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Chlorobenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Chloroethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Chloroform	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Chloromethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Cumene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Cyclohexane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Dibromochloromethane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Dichlorodifluoromethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Ethylbenzene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Methyl acetate	1.5	2.3 R	18 U	13 U	12 U	12 U	2.2	13 UJ	13 U	16 J	3.1 J	1.6	16 UJ	8.5 J	18 UJ
Methyl-tert-butyl ether (MTBE)	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Methylcyclohexane	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
Methylene chloride	14 U	1.5 B	2.2 U	4 B	5.2 B	3.2 B	2.1 B	5.7 B	2 B	33 UJ	4.5 B	1.4 B	1.8 B	28 UJ	3.3 B
Styrene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
TPH-gas range	NA	140 U	180 U	130 U	120 U	120 U	120 U	130 U	130 U	330 U	130 U	130 U	160 U	280 U	180 U
Tetrachloroethene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Toluene	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	1.6	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
Trichloroethene	14 U	14 U	18 UJ	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	1.6 J	4.4	9.6 J	28 UJ	18 UJ
Trichlorofluoromethane	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Vinyl chloride	14 U	14 U	18 U	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
Xylene, total	14 U	14 U	18 UJ	13 UJ	12 UJ	12 UJ	12 U	13 UJ	13 U	33 UJ	13 UJ	13 UJ	16 UJ	28 UJ	18 UJ
cis-1,2-Dichloroethene	14 U	14 U	18 UJ	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
cis-1,3-Dichloropropene	14 U	14 U	18 J	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ
trans-1,2-Dichloroethene	14 U	14 U	18 UJ	13 U	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 U	13 U	16 UJ	28 UJ	18 UJ
trans-1,3-Dichloropropene	14 U	14 U	18 J	13 UJ	12 U	12 U	12 U	13 UJ	13 U	33 UJ	13 UJ	13 U	16 UJ	28 UJ	18 UJ

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO24		IS11SO25	IS11SO26	IS11SO27		IS11SO28	IS11SO29	IS11SO30	IS11SO31	IS11SO32	IS11SO33		IS11SO34	IS11SO35
Sample ID	IS11SS240001	IS11SS240001P	IS11SS250001	IS11SS260001	IS11SS270001	IS11SS270001P	IS11SS280001	IS11SS290001	IS11SS300001	IS11SS310001	IS11SS320001	IS11SS330001	IS11SS330001P	IS11SS340001	IS11SS350001
Sample Date	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00
Chemical Name															
Semi-volatile Organic Compounds (UG/KG)															
1,1-Biphenyl	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2,2'-Oxybis(1-chloropropane)	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2,4,5-Trichlorophenol	1,200 U	1,100 U	1,500 UL	1,100 U	1,000 U	1,000 U	1,000 U	2,100 U	1,100 U	2,700 U	1,100 U	1,100 U	1,400 U	2,300 U	1,500 U
2,4,6-Trichlorophenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2,4-Dichlorophenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2,4-Dimethylphenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2,4-Dinitrophenol	1,200 R	1,100 R	1,500 R	1,100 R	1,000 R	1,000 R	1,000 R	2,100 R	1,100 R	2,700 R	1,100 R	1,100 R	1,400 R	2,300 R	1,500 R
2-Chloronaphthalene	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2-Chlorophenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2-Methylnaphthalene	470 U	450 U	590 UL	80 J	68 J	400 U	410 U	850 U	420 U	130 J	430 U	440 U	540 U	930 U	590 U
2-Methylphenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
2-Nitroaniline	1,200 U	1,100 U	1,500 UL	1,100 U	1,000 U	1,000 U	1,000 U	2,100 U	1,100 U	2,700 U	1,100 U	1,100 U	1,400 U	2,300 U	1,500 U
2-Nitrophenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
3,3'-Dichlorobenzidine	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
3-Nitroaniline	1,200 U	1,100 U	1,500 UL	1,100 U	1,000 U	1,000 U	1,000 U	2,100 U	1,100 U	2,700 U	1,100 U	1,100 U	1,400 U	2,300 U	1,500 U
4,6-Dinitro-2-methylphenol	1,200 UJ	1,100 UJ	1,500 UL	1,100 UJ	1,000 UJ	1,000 UJ	1,000 UJ	2,100 UJ	1,100 UJ	2,700 UJ	1,100 UJ	1,100 UJ	1,400 UJ	2,300 UJ	1,500 UJ
4-Bromophenyl-phenylether	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
4-Chloro-3-methylphenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
4-Chloroaniline	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
4-Chlorophenyl-phenylether	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
4-Methylphenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
4-Nitroaniline	1,200 U	1,100 U	1,500 UL	1,100 U	1,000 U	1,000 U	1,000 U	2,100 U	1,100 U	2,700 U	1,100 U	1,100 U	1,400 U	2,300 U	1,500 U
4-Nitrophenol	1,200 U	1,100 U	1,500 UL	1,100 U	1,000 U	1,000 U	1,000 U	2,100 U	1,100 U	2,700 U	1,100 U	1,100 U	1,400 U	2,300 U	1,500 U
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	130 J	420 U	250 J	430 U	110 J	540 U	930 U	590 U
Acenaphthylene	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Acetophenone	57 J	450 U	590 UL	89 J	82 J	61 J	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Anthracene	470 U	450 U	590 UL	430 U	410 U	45 J	410 U	540 J	420 U	500 J	430 U	230 J	77 J	930 U	140 J
Atrazine	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Benzaldehyde	470 U	450 U	590 UL	97 J	58 J	55 J	110 J	850 U	420 U	1,100 U	430 U	440 U	540 U	150 J	63 J
Benzo(a)anthracene	130 J	98 J	590 UL	210 J	210 J	290 J	210 J	2,600	66 J	2,700	250 J	880	160 J	240 J	880
Benzo(a)pyrene	470 U	450 U	590 L	47 J	63 J	76 J	58 J	510 J	100 J	860 J	110 J	210 J	540 U	390 J	170 J
Benzo(b)fluoranthene	250 J	200 J	68 UL	370 J	350 J	460	350 J	2,800	170 J	4,300	460	1,100	160 J	810 J	1,100
Benzo(g,h,i)perylene	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Benzo(k)fluoranthene	100 J	81 J	590 UL	130 J	150 J	180 J	140 J	1,500	61 J	1,400	130 J	610	83 J	280 J	560 J
Butylbenzylphthalate	470 U	450 U	590 UL	430 U	67 J	86 J	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Caprolactam	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Carbazole	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	180 J	420 U	210 J	430 U	89 J	540 U	930 U	590 U
Chrysene	180 J	150 J	590 UL	240 J	250 J	340 J	240 J	2,400	110 J	2,900	280 J	870	160 J	390 J	950
Di-n-butylphthalate	470 U	450 U	590 UL	94 J	82 J	78 J	410 U	280 J	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Di-n-octylphthalate	470 U	450 U	590 L	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Dibenz(a,h)anthracene	470 U	450 U	590 UL	51 J	48 J	66 J	47 J	390 J	420 U	590 J	57 J	130 J	540 U	930 U	130 J
Dibenzofuran	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	110 J	420 U	130 J	430 U	440 U	540 U	930 U	590 U
Diethylphthalate	470 U	450 U	590 UL	430 U	46 J	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Dimethyl phthalate	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Fluoranthene	240 J	180 J	590	300 J	330 J	450	370 J	5,000	140 J	4,000	410 J	1,600	380 J	480 J	1,300
Fluorene	470 U	450 U	590	430 U	410 U	400 U	410 U	140 J	420 U	200 J	430 U	88 J	540 U	930 U	590 U
Hexachlorobenzene	470 U	450 U	590	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Hexachlorobutadiene	470 U	450 U	590	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Hexachlorocyclopentadiene	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Hexachloroethane	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Indeno(1,2,3-cd)pyrene	470 U	450 U	590 UL	80 J	82 J	100 J	80 J	510 J	80 J	990 J	120 J	240 J	540 U	390 J	160 J
Isophorone	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Naphthalene	470 U	450 U	590 UL	52 J	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Pentachlorophenol	1,100 U	1,100 U	1,400 UL	1,000 U	990 U	980 U	1,000 U	2,100 U	1,000 U	2,600 U	1,000 U	1,100 U	1,300 U	2,200 U	1,400 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO24		IS11SO25	IS11SO26	IS11SO27		IS11SO28	IS11SO29	IS11SO30	IS11SO31	IS11SO32	IS11SO33		IS11SO34	IS11SO35
Sample ID	IS11SS240001	IS11SS240001P	IS11SS250001	IS11SS260001	IS11SS270001	IS11SS270001P	IS11SS280001	IS11SS290001	IS11SS300001	IS11SS310001	IS11SS320001	IS11SS330001	IS11SS330001P	IS11SS340001	IS11SS350001
Sample Date	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00
Chemical Name															
Phenanthrene	69 J	450 U	590 UL	130 J	160 J	220 J	160 J	2,300	53 J	1,900	170 J	920	310 J	210 J	390 J
Phenol	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
Pyrene	130 J	90 J	590 UL	170 J	200 J	240 J	200 J	2,100	240 J	1,700	210 J	680	130 J	900 J	610
bis(2-Chloroethoxy)methane	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
bis(2-Chloroethyl)ether	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
bis(2-Ethylhexyl)phthalate	71 J	51 J	1,200 L	260 J	380 J	290 J	210 J	150 J	280 J	2,600	210 J	160 J	3,300	220 J	72 J
n-Nitroso-di-n-propylamine	470 U	450 U	590 UL	430 U	410 U	400 U	410 U	850 U	420 U	1,100 U	430 U	440 U	540 U	930 U	590 U
n-Nitrosodiphenylamine	470 U	450 U	590 UL	430 U	66 J	400 U	410 U	130 J	420 U	1,100 U	430 U	81 J	540 U	930 U	590 U
Explosives (UG/KG)															
1,3,5-Trinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-Trinitrotoluene	250 U	250 U	250 U	360	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	250 U	250 U	250 U	90 J	250 U	98 J	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	250 U	250 U	250 U	130 J	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	250 U	250 U	170 J	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	390 U
3-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	250 U	250 U	250 U	170 J	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	1,200 U
4-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Ammonium perchlorate	130 U	99 U	160 U	480,000	78 J	110	97 U	140	100 U	280 U	120 U	150 U	130 U	220 U	170 U
HMX	500 U	500 U	500 U	3,700	1,900	2,100	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Nitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	870 U
Nitroglycerin	2,500 U	1,300 U	1,500 U	1,200 U	1,200 U	1,200 U	1,200 U	1,200 U	1,200 U	2,700 U	1,200 U	1,800 U	1,600 U	3,100 U	2,400 U
Nitroguanidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PETN	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
RDX	500 U	500 U	500 U	530	730	860	500 U	190 J	500 U	500 U	500 U	500 U	910 U	500 U	500 U
Tetryl	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U
Total Metals (MG/KG)															
Aluminum	5,810	5,240	12,700	25,600	21,100	25,300	8,070	8,450	11,100	14,500	14,100	14,600	11,200	10,900	11,700
Antimony	10.4 L	10.1 L	1.5 UL	11.8 L	17 L	12.5 L	1.7 L	7.2 L	1.1 L	18.9 L	6.2 L	2.5 L	2.8 L	2.4 UL	1.5 UL
Arsenic	11.1 L	11.9 L	5.8 L	42.7 L	35.8 L	31.6 L	6.3 L	12.8 L	11.6 L	13.4 L	12.4 L	11.3 L	10.6 L	2.3 L	1.7 L
Barium	85.4	65.8	137	248	264	249	52.2	286	67.6	160	120	107	90.2	8.4 J	7.9 J
Beryllium	0.38 B	0.17 B	0.98 B	0.053 U	0.05 U	0.049	0.05 U	0.052 U	0.26 B	0.39 B	0.096 B	0.35 B	0.39 B	0.11 U	0.072 U
Cadmium	9.5 J	6.8 J	4.5 J	145 J	147 J	130 J	17.3 J	35 J	5.2 J	48.3 J	49.2 J	31.3 J	25.5 J	0.24 B	0.14
Calcium	1,940	1,440 J	2,470 J	8,300 J	7,870 J	7,520 J	1,080 J	5,250 J	2,480 J	7,330 J	2,310 J	1,580 J	1,760 J	184,000 J	124,000 J
Chromium	57 L	24.3 L	22.2 L	156 L	128 L	143 L	19.6 L	58.6 L	46.7 L	56 L	71.1 L	31.4 L	38.2 L	3.8 L	3.6 L
Cobalt	9.2 J	6.7 J	12.2 J	12.9	14.3	12 J	5.1 J	6.8 J	5.3 J	11.6 J	10.2 J	8.2 J	11.2 J	1.2 U	0.79 U
Copper	4,960 J	1,640 J	39.9	1,840 J	2,680 J	4,320 J	136 J	441 J	39.6 J	560 J	857 J	552 J	786 J	2.1 J	3.7 J
Cyanide	0.33 J	0.39 B	0.89 U	0.52 J	0.3 J	0.093 J	0.62 U	0.09 J	0.094 J	0.19 J	0.21 J	0.081 J	0.21 J	0.16 J	0.23 J
Iron	212,000 J	62,500 J	24,100 J	108,000 J	110,000 J	155,000 J	21,900 J	66,600 J	20,100 J	40,300 J	64,600 J	54,100 J	54,400 J	24,700 J	33,000
Lead	278 J	174 J	94.7 J	1,540 J	2,580 J	1,610 J	351 J	2,260 J	141 J	945 J	638 J	345 J	389 J	2.6 J	3.5 J
Magnesium	942 J	788 J	2,200	5,300	11,500	4,640	1,100 J	3,030	1,020 J	4,130	3,830	2,950	7,850	1,560 J	1,510
Manganese	423 L	325 L	156 L	728 L	892 L	710 L	136 L	295 L	142 L	295 L	446 L	604 L	581 L	48.5 L	33 L
Mercury	0.64 J	0.31 J	0.24 J	1.7 J	2.1 J	2 J	0.94 J	8.6 J	0.55 J	1.2 J	1.7 J	0.3 J	0.65 J	0.14 UL	0.09 UL
Nickel	28.8	24.3	21.7	115	127	157	15.6	42.6	13.1	56.4	65	54.2	38.6	1.1 U	1.2 J
Potassium	654 J	565 J	1,130 J	1,290 J	903 J	794 J	463 J	771 J	617 J	1,120 J	780 J	387 J	496 J	123 J	95.7 J
Selenium	1.2 UL	1.2 UL	1.5 UL	1.1 UL	1.1 UL	1.1 UL	1.1 UL	1.1 UL	1.1 UL	2.8 UL	1.1 UL	1.1 UL	1.4 UL	2.4 UL	1.5 UL
Silver	14	7.8	1.1 U	27.4	22.2	44.5	6.4	10.6	8.1	62.5	18.4	6.9	7.4	1.7 U	1.1 U
Sodium	185 B	233 B	471 B	1,270 J	1,220 J	857 B	297 B	454 B	208 B	894 B	395 B	333 B	371 B	2,120 J	1,350 J
Thallium	1.6 B	1.5 J	1.9 U	1.4 U	1.8 J	1.6 J	1.3 U	1.4 U	1.4 U	3.5 U	1.4 U	1.4 U	1.7 U	3 U	1.9 U
Vanadium	18.2	14.2	29.7	36.8	36.4	43.3	24.2	33.1	25.6	60.2	45.6	18.5	23.5	3.9 J	3.7 J
Zinc	683 J	383	203 J	4,980 J	8,820 J	5,720 J	396 J	2,120 J	181 J	1,880 J	1,820 J	1,120 J	1,040 J	13.4 J	12.4 J

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO24		IS11SO25	IS11SO26	IS11SO27		IS11SO28	IS11SO29	IS11SO30	IS11SO31	IS11SO32	IS11SO33		IS11SO34	IS11SO35
Sample ID	IS11SS240001	IS11SS240001P	IS11SS250001	IS11SS260001	IS11SS270001	IS11SS270001P	IS11SS280001	IS11SS290001	IS11SS300001	IS11SS310001	IS11SS320001	IS11SS330001	IS11SS330001P	IS11SS340001	IS11SS350001
Sample Date	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00	07/19/00
Chemical Name															
Wet Chemistry (MG/KG)															
% Moisture	29.3 J	26.8	44	23.8	19.1	18.2	19.6	22.3	21.2	69.7	22.5	24.9	38.9	64.4	44.2
% Solids	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (MG/KG)															
TPH-diesel range	26	57	41	240	150	94	44	160	20	400	34	120	130	130	48
TPH-gas range	0.14 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO36	IS11SO37	IS11SO38	IS11SO39	IS11SO40	IS11SO41		IS11SO42
Sample ID	IS11SS360001	IS11SS370001	IS11SS380001	IS11SS390001	IS11SS400001	IS11SS410001	IS11SS410001P	IS11SS420001
Sample Date	07/19/00	07/19/00	07/19/00	08/04/00	08/04/00	08/04/00	08/04/00	07/27/00
Chemical Name								
Volatile Organic Compounds (UG/KG)								
1,1,1-Trichloroethane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
1,1,2,2-Tetrachloroethane	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
1,1,2-Trichloro-1,2,2- trifluoroethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
1,1,2-Trichloroethane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
1,1-Dichloroethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
1,1-Dichloroethene	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
1,2,4-Trichlorobenzene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
1,2-Dibromo-3-chloropropane	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 R
1,2-Dibromoethane	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
1,2-Dichlorobenzene	16 UJ	12 UJ	16 UJ	13 U	14 U	12 U	13 U	15 U
1,2-Dichloroethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
1,3-Dichlorobenzene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
1,4-Dichlorobenzene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
2-Butanone	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
2-Hexanone	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
4-Methyl-2-pentanone	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
Acetone	16 U	3.1 J	9.9 J	16 B	7 B	4.7 B	2.3 B	5.3 B
Benzene	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Bromodichloromethane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Bromoform	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Bromomethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Carbon disulfide	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Carbon tetrachloride	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Chlorobenzene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
Chloroethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Chloroform	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Chloromethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Cumene	16 UJ	12 UJ	16 UJ	13 U	14 U	12 U	13 U	15 U
Cyclohexane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	3.6 J
Dibromochloromethane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Dichlorodifluoromethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Ethylbenzene	16 UJ	12 UJ	16 UJ	13 U	2.4 J	12 U	13 U	15 U
Methyl acetate	16 U	12 U	16 U	2.3 J	14 U	12 U	13 U	15 U
Methyl-tert-butyl ether (MTBE)	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Methylcyclohexane	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Methylene chloride	16 U	12 U	16 U	13 U	2.6 B	1.3 B	13 U	15 U
Styrene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
TPH-gas range	160 U	120 U	NA	NA	NA	NA	NA	NA
Tetrachloroethene	16 UJ	12 UJ	16 UJ	13 U	14 UJ	12 U	13 U	15 U
Toluene	16 UJ	12 UJ	16 UJ	70	140 J	42	23	15 U
Trichloroethene	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
Trichlorofluoromethane	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Vinyl chloride	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
Xylene, total	16 UJ	12 UJ	16 UJ	13 U	5.2 J	1.7 J	13 U	9.9 J
cis-1,2-Dichloroethene	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
cis-1,3-Dichloropropene	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U
trans-1,2-Dichloroethene	16 U	12 U	16 U	13 U	14 U	12 U	13 U	15 U
trans-1,3-Dichloropropene	16 UJ	12 U	16 UJ	13 U	14 U	12 U	13 U	15 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO36	IS11SO37	IS11SO38	IS11SO39	IS11SO40	IS11SO41		IS11SO42
Sample ID	IS11SS360001	IS11SS370001	IS11SS380001	IS11SS390001	IS11SS400001	IS11SS410001	IS11SS410001P	IS11SS420001
Sample Date	07/19/00	07/19/00	07/19/00	08/04/00	08/04/00	08/04/00	08/04/00	07/27/00
Chemical Name								
Semi-volatile Organic Compounds (UG/KG)								
1,1-Biphenyl	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2,2'-Oxybis(1-chloropropane)	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2,4,5-Trichlorophenol	1,300 U	970 U	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
2,4,6-Trichlorophenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2,4-Dichlorophenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2,4-Dimethylphenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2,4-Dinitrophenol	1,300 R	970 R	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 R
2-Chloronaphthalene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2-Chlorophenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2-Methylnaphthalene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2-Methylphenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
2-Nitroaniline	1,300 U	970 U	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
2-Nitrophenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
3,3'-Dichlorobenzidine	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
3-Nitroaniline	1,300 U	970 U	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
4,6-Dinitro-2-methylphenol	1,300 UJ	970 UJ	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
4-Bromophenyl-phenylether	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
4-Chloro-3-methylphenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
4-Chloroaniline	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
4-Chlorophenyl-phenylether	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
4-Methylphenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
4-Nitroaniline	1,300 U	970 U	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
4-Nitrophenol	1,300 U	970 U	1,300 U	1,100 U	1,100 U	1,000 U	1,100 U	1,200 U
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Acenaphthylene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Acetophenone	520 U	380 U	64 J	430 U	64 J	400 U	430 U	490 U
Anthracene	520 U	90 J	530 U	430 U	450 U	400 U	430 U	490 U
Atrazine	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Benzaldehyde	520 U	47 J	56 J	430 U	450 U	400 U	430 U	490 U
Benzo(a)anthracene	520 U	400	530 U	430 U	450 U	400 U	430 U	490 U
Benzo(a)pyrene	520 U	79 J	530 U	430 U	450 U	400 U	430 U	490 U
Benzo(b)fluoranthene	520 U	620	530 U	430 U	450 U	400 U	430 U	490 U
Benzo(g,h,i)perylene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Benzo(k)fluoranthene	520 U	300 J	530 U	430 U	450 U	400 U	430 U	490 U
Butylbenzylphthalate	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Caprolactam	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Carbazole	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Chrysene	520 U	570	530 U	430 U	450 U	400 U	430 U	490 U
Di-n-butylphthalate	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Di-n-octylphthalate	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Dibenz(a,h)anthracene	520 U	77 J	530 U	430 U	450 U	400 U	430 U	490 U
Dibenzofuran	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Diethylphthalate	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Dimethyl phthalate	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Fluoranthene	520 U	940	530 U	430 U	65 J	400 U	430 U	490 U
Fluorene	520 U	47 J	530 U	430 U	450 U	400 U	430 U	490 U
Hexachlorobenzene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Hexachlorobutadiene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Hexachlorocyclopentadiene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Hexachloroethane	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Indeno(1,2,3-cd)pyrene	520 U	100 J	530 U	430 U	450 U	400 U	430 U	490 U
Isophorone	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Naphthalene	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Pentachlorophenol	1,300 U	930 U	1,300 U	1,100 U	1,100 U	980 U	1,000 U	1,200 U

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO36	IS11SO37	IS11SO38	IS11SO39	IS11SO40	IS11SO41		IS11SO42
Sample ID	IS11SS360001	IS11SS370001	IS11SS380001	IS11SS390001	IS11SS400001	IS11SS410001	IS11SS410001P	IS11SS420001
Sample Date	07/19/00	07/19/00	07/19/00	08/04/00	08/04/00	08/04/00	08/04/00	07/27/00
Chemical Name								
Phenanthrene	520 U	410	530 U	430 U	450 U	400 U	430 U	490 U
Phenol	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Pyrene	60 J	400	530 U	430 U	120 J	400 U	430 U	490 U
bis(2-Chloroethoxy)methane	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
bis(2-Chloroethyl)ether	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
bis(2-Ethylhexyl)phthalate	520 U	1,700	530 U	430 U	450 U	400 U	430 U	490 U
n-Nitroso-di-n-propylamine	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
n-Nitrosodiphenylamine	520 U	380 U	530 U	430 U	450 U	400 U	430 U	490 U
Explosives (UG/KG)								
1,3,5-Trinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-Trinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	250 U	250 U	250 U	250 U	150 J	250 U	250 U	250 U
3-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Nitrotoluene	250 U	250 U	250 U	250 U	210 J	250 U	250 U	250 U
Ammonium perchlorate	130 U	93 U	150 U	99 U	110 U	98 U	100 U	130 U
HMX	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Nitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Nitroglycerin	1,600 U	1,200 U	1,400 U	1,300 U	1,400 U	1,200 U	1,200 U	1,600 U
Nitroguanidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PETN	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
RDX	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Tetryl	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U
Total Metals (MG/KG)								
Aluminum	9,050	10,100	6,590	12,900 J	3,960 J	10,300 J	7,500 J	5,930
Antimony	1.4 UL	1 R	1.4 UL	1.1 UL	1.2 UL	1.1 UL	1.1 UL	1.3 UL
Arsenic	3.8 L	4.2 L	3.5	7.1 L	2.7 L	4.3 L	4.1 L	2.2 J
Barium	54.6 J	42.6 J	56.3 J	52.6 J	49.1 J	58.4	63.3	68.6
Beryllium	0.28 B	0.31 B	0.34 B	0.5 J	0.074 B	0.46 J	0.47 J	0.15 B
Cadmium	0.35 B	0.26 B	0.68 J	0.2 J	0.12 J	0.098	0.25 J	0.24 B
Calcium	1,420 J	504 B	1,520 J	497 J	176 J	512 J	597 J	682 J
Chromium	9.5 L	9.8	11.3	16.1	5.6	14	11.6	7.1
Cobalt	7.6 J	7.8 J	9.4 J	7.1 J	2.2 J	10.1 J	8.3 J	13 J
Copper	8.8 J	10.2	17	9.5	5.2 J	9.7	11.6	7.7
Cyanide	0.16 J	0.21 B	0.2 B	0.66	0.073 B	0.11 B	0.17 B	0.11 B
Iron	15,100 J	13,000	13,000	24,400	5,680	21,300	20,100	6,870 J
Lead	17.1 J	28.5	32.9 K	12.5	24.3	13.8	15.5	29.4 K
Magnesium	952 J	640 J	1,040 J	714 J	256 J	837 J	743 J	484 J
Manganese	326 L	260	511	222	17.4	156	595	792 J
Mercury	0.079 UL	0.066 J	0.083 J	0.066 UL	0.093 L	0.061 UL	0.065 UL	0.11
Nickel	6.5 J	5.9 J	11.4 J	8.8 J	3.5 J	9.5 J	18.6	8.1 J
Potassium	310 J	400 J	524 J	543 J	281 J	721 J	590 J	395 J
Selenium	1.4 UL	1 U	1.4 U	1.1	1.2	1.1	1.1 U	1.3 U
Silver	0.98 U	0.72 U	1 U	0.82	0.84	0.76	0.81	0.92 U
Sodium	425 B	216 B	525 B	116	120	108	115	358 B
Thallium	1.7 U	1.2 U	1.7 U	1.4	1.4	1.3	1.4	1.6 U
Vanadium	20.7	20.3	21.5	26.7	13.9	24.8	22	24
Zinc	33 J	32.5 J	72.4 J	27 J	17.3 J	33.5 J	33.6 J	21.3 J

Table B-1
Analytical Results for Site 11 Surface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO36	IS11SO37	IS11SO38	IS11SO39	IS11SO40	IS11SO41		IS11SO42
Sample ID	IS11SS360001	IS11SS370001	IS11SS380001	IS11SS390001	IS11SS400001	IS11SS410001	IS11SS410001P	IS11SS420001
Sample Date	07/19/00	07/19/00	07/19/00	08/04/00	08/04/00	08/04/00	08/04/00	07/27/00
Chemical Name								
Wet Chemistry (MG/KG)								
% Moisture	36.7	14.2	38.1	24.1	26.5	18.3	23.4	32.9
% Solids	NA	NA	NA	NA	NA	NA	NA	66
Total organic carbon (TOC)	NA	NA	NA	NA	NA	NA	NA	40,100
pH	NA	NA	NA	NA	NA	NA	NA	5.7
Total Petroleum Hydrocarbons (MG/KG)								
TPH-diesel range	32	17	29	4 U	47	3.8	4.8	15
TPH-gas range	NA	NA	0.16 U	0.13 U	0.14 U	0.18	0.13 U	0.17

Notes:
NA - Not analyzed.
B - Result is not significantly greater than that detected in an associated blank.
J - Analyte was detected, but the reported result may be inaccurate or imprecise.
K - Analyte was detected, but the reported result may be biased high.
L - Analyte was detected, but the reported result may be biased low.
R - Rejected. Unreliable result.
U - Not detected greater than the reported detection limit.
UJ - Not detected. The reported detection limit is estimated.
UL - Not detected. The detection limit may be higher than reported.

Table B-2
Analytical Results for Site 11 Subsurface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO20	IS11SO21	IS11SO39	IS11SO40	IS11SO41	IS11SO42	IS11SO43
Sample ID	IS11SB120103	IS11SB090102	IS11SB230203	IS11SB240203	IS11SB250203	IS11SB260203	IS11SB040608
Sample Date	07/26/00	07/26/00	08/04/00	08/04/00	08/04/00	07/27/00	07/25/00
Chemical Name							
Volatile Organic Compounds (UG/KG)							
1,1,1-Trichloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,1,2,2-Tetrachloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,1,2-Trichloro-1,2,2- trifluoroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,1,2-Trichloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,1-Dichloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,1-Dichloroethene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,2,4-Trichlorobenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,2-Dibromo-3-chloropropane	14 R	12 R	12 U	12 U	14 U	13 R	13 U
1,2-Dibromoethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,2-Dichlorobenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,2-Dichloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	13 U
1,2-Dichloropropane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,3-Dichlorobenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
1,4-Dichlorobenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
2-Butanone	14 U	12 U	12 U	12 U	14 U	1.3 B	4.3 J
2-Hexanone	14 U	12 U	12 U	12 U	14 U	13 U	13 U
4-Methyl-2-pentanone	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Acetone	14 U	2.6 J	7.6 B	2.6 B	2.8 B	2 B	17
Benzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Bromodichloromethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Bromoform	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Bromomethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Carbon disulfide	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Carbon tetrachloride	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Chlorobenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Chloroethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Chloroform	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Chloromethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Cumene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Cyclohexane	4.5 J	2.3 J	12 U	12 U	14 U	13 U	13 U
Dibromochloromethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Dichlorodifluoromethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Ethylbenzene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Methyl acetate	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Methyl-tert-butyl ether (MTBE)	14 U	12 U	12 U	12 U	14 U	13 U	13 U

Table B-2
Analytical Results for Site 11 Subsurface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID Sample ID Sample Date	IS11SO20 IS11SB120103 07/26/00	IS11SO21 IS11SB090102 07/26/00	IS11SO39 IS11SB230203 08/04/00	IS11SO40 IS11SB240203 08/04/00	IS11SO41 IS11SB250203 08/04/00	IS11SO42 IS11SB260203 07/27/00	IS11SO43 IS11SB040608 07/25/00
Chemical Name							
Methylcyclohexane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Methylene chloride	14 U	12 U	12 U	12 U	1.5 B	13 U	13 U
Styrene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Tetrachloroethene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Toluene	14 U	12 U	3.3 J	12 U	14 U	13 U	13 U
Trichloroethene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Trichlorofluoromethane	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Vinyl chloride	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Xylene, total	1.8 J	12 U	12 U	9 J	14 U	2.4 J	13 U
cis-1,2-Dichloroethene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
cis-1,3-Dichloropropene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
trans-1,2-Dichloroethene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
trans-1,3-Dichloropropene	14 U	12 U	12 U	12 U	14 U	13 U	13 U
Semi-volatile Organic Compounds (UG/KG)							
1,1-Biphenyl	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2,2'-Oxybis(1-chloropropane)	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2,4,5-Trichlorophenol	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 U
2,4,6-Trichlorophenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2,4-Dichlorophenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2,4-Dimethylphenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2,4-Dinitrophenol	1,200 R	970 R	970 U	980 U	1,100 U	1,000 R	1,000 UJ
2-Chloronaphthalene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2-Chlorophenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2-Methylnaphthalene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2-Methylphenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
2-Nitroaniline	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 U
2-Nitrophenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
3,3'-Dichlorobenzidine	470 U	390 U	390 U	390 U	450 U	410 U	410 U
3-Nitroaniline	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 U
4,6-Dinitro-2-methylphenol	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 UJ
4-Bromophenyl-phenylether	470 U	390 U	390 U	390 U	450 U	410 U	410 U
4-Chloro-3-methylphenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
4-Chloroaniline	470 U	390 U	390 U	390 U	450 U	410 U	410 U
4-Chlorophenyl-phenylether	470 U	390 U	390 U	390 U	450 U	410 U	410 U
4-Methylphenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
4-Nitroaniline	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 U
4-Nitrophenol	1,200 U	970 U	970 U	980 U	1,100 U	1,000 U	1,000 U

Table B-2
Analytical Results for Site 11 Subsurface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO20	IS11SO21	IS11SO39	IS11SO40	IS11SO41	IS11SO42	IS11SO43
Sample ID	IS11SB120103	IS11SB090102	IS11SB230203	IS11SB240203	IS11SB250203	IS11SB260203	IS11SB040608
Sample Date	07/26/00	07/26/00	08/04/00	08/04/00	08/04/00	07/27/00	07/25/00
Chemical Name							
Acenaphthene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Acenaphthylene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Acetophenone	65 J	390 U	390 U	390 U	450 U	410 U	48 J
Anthracene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Atrazine	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Benzaldehyde	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Benzo(a)anthracene	470 U	390 U	390 U	390 U	450 U	410 U	63 J
Benzo(a)pyrene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Benzo(b)fluoranthene	470 U	390 U	390 U	390 U	450 U	410 U	110 J
Benzo(g,h,i)perylene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Benzo(k)fluoranthene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Butylbenzylphthalate	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Caprolactam	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Carbazole	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Chrysene	470 U	390 U	390 U	390 U	450 U	410 U	76 J
Di-n-butylphthalate	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Di-n-octylphthalate	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Dibenz(a,h)anthracene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Dibenzofuran	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Diethylphthalate	470 U	390 U	390 U	390 U	450 U	410 U	43 J
Dimethyl phthalate	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Fluoranthene	470 U	390 U	390 U	390 U	450 U	410 U	120 J
Fluorene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Hexachlorobenzene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Hexachlorobutadiene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Hexachlorocyclopentadiene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Hexachloroethane	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Indeno(1,2,3-cd)pyrene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Isophorone	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Naphthalene	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Nitrobenzene	NA	NA	NA	NA	NA	NA	410 U
Pentachlorophenol	1,100 U	940 U	940 U	940 U	1,100 U	1,000 U	1,000 U
Phenanthrene	470 U	390 U	390 U	390 U	450 U	410 U	49 J
Phenol	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Pyrene	470 U	390 U	390 U	390 U	450 U	410 U	48 J
bis(2-Chloroethoxy)methane	470 U	390 U	390 U	390 U	450 U	410 U	410 U
bis(2-Chloroethyl)ether	470 U	390 U	390 U	390 U	450 U	410 U	410 U
bis(2-Ethylhexyl)phthalate	470 U	47 J	390 U	390 U	450 U	410 U	890

Table B-2
Analytical Results for Site 11 Subsurface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO20	IS11SO21	IS11SO39	IS11SO40	IS11SO41	IS11SO42	IS11SO43
Sample ID	IS11SB120103	IS11SB090102	IS11SB230203	IS11SB240203	IS11SB250203	IS11SB260203	IS11SB040608
Sample Date	07/26/00	07/26/00	08/04/00	08/04/00	08/04/00	07/27/00	07/25/00
Chemical Name							
n-Nitroso-di-n-propylamine	470 U	390 U	390 U	390 U	450 U	410 U	410 U
n-Nitrosodiphenylamine	470 U	390 U	390 U	390 U	450 U	410 U	410 U
Explosives (UG/KG)							
1,3,5-Trinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	33 J	250 U	250 U	250 U	250 U	32 J	250 U
2,4,6-Trinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
3-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Amino-2,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Ammonium perchlorate	100 U	91 U	97 U	96 U	100 U	110 U	100 U
HMX	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Nitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Nitroglycerin	1,200 U	1,200 U	1,200 U	1,100 U	1,400 U	1,300 U	1,300 U
Nitroguanidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PETN	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
RDX	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Tetryl	650 U	650 U	650 U	650 U	650 U	650 U	650 U
Total Metals (MG/KG)							
Aluminum	9,660	4,530	9,430 J	10,500 J	17,900 J	15,400	10,500
Antimony	1.2 UL	1 UL	1 UL	1 UL	1.2 UL	1.1 UL	1.1 R
Arsenic	3	1.7 J	6.8 L	4.3 L	5.1 L	4.3	3.6 L
Barium	46.7 J	40.1 J	36.7 J	40.9 J	65.5	64	85
Beryllium	0.17 B	0.41 B	0.25 B	0.28 J	0.36 B	0.39 J	0.59 B
Cadmium	0.77 J	0.17	0.1 J	0.095	0.14 J	0.38 B	0.82 B
Calcium	290 J	79.2 B	170 J	75.4 J	130 J	134 B	1,780 J
Chromium	13.7	6.8	12.5	12.4	19.3	15.7	20
Cobalt	4.6 J	3.6 J	5.4 J	5.5 J	4.9 J	4.3 J	14
Copper	12.4	3.9 J	7.5	6.3	8.6	6.4 J	57 J
Cyanide	2.8 U	2.3 U	0.59	0.59	0.68	2.5 U	0.16 B
Iron	15,400 J	7,850 J	23,800	16,100	36,800	26,000 K	25,500
Lead	15.8 K	5.5 K	7.6	8.7	13.7	12.5 J	58.1 J
Magnesium	799 J	1,100 J	664 J	501 J	819 J	642 J	2,980

Table B-2
Analytical Results for Site 11 Subsurface Soil Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SO20	IS11SO21	IS11SO39	IS11SO40	IS11SO41	IS11SO42	IS11SO43
Sample ID	IS11SB120103	IS11SB090102	IS11SB230203	IS11SB240203	IS11SB250203	IS11SB260203	IS11SB040608
Sample Date	07/26/00	07/26/00	08/04/00	08/04/00	08/04/00	07/27/00	07/25/00
Chemical Name							
Manganese	19.1 J	38.8 J	120	39.7	23.7	15.9 J	346 L
Mercury	0.071 UL	0.059 UL	0.059 UL	0.059 UL	0.18 L	0.063 UL	0.078 L
Nickel	7.1 J	3.9 J	7.2 J	6.5 J	8.1 J	6.4 J	23.5
Potassium	617 J	353 J	524 J	565 J	653 J	548 J	1,040 B
Selenium	1.2 UL	1 UL	1 U	1	1.2	1.1 UL	1.1 U
Silver	0.88 U	0.73 U	0.73	0.73	0.85	0.78 U	3.2 J
Sodium	546 B	296 B	103	104	120	447 B	422 B
Thallium	1.5 U	1.2 U	1.2 U	1.3	1.4	1.3 U	1.3 U
Vanadium	22.3	11.1 J	19.9	22.4	31.7	30.1	23.7
Zinc	43.3 J	17.4 J	21 J	20.6 J	27.7 J	24.7 J	126 K
Wet Chemistry (MG/KG)							
% Moisture	29.6	14.5	14.5	15.3	26.6	20	20.1
Total Petroleum Hydrocarbons (MG/KG)							
TPH-diesel range	4.3 U	3.5 U	3.5 U	3.5 U	4.1 U	3.8 U	31
TPH-gas range	0.14 U	0.12 U	0.12 U	0.12 U	0.14 U	0.13 U	0.13 U

Notes:
NA - Not analyzed.
B - Result is not significantly greater than that detected in an associated blank.
J - Analyte was detected, but the reported result may be inaccurate or imprecise.
K - Analyte was detected, but the reported result may be biased high.
L - Analyte was detected, but the reported result may be biased low.
R - Rejected. Unreliable result.
U - Not detected greater than the reported detection limit.
UJ - Not detected. The reported detection limit is estimated.
UL - Not detected. The detection limit may be higher than reported.

Table B-3
Analytical Results for Site 11 Sediment Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SD01	IS11SD02	IS11SD03	IS11SD04	IS11SD05	IS11SD06	IS11SD07
Sample ID	IS11SD010001	IS11SD020001	IS11SD030001	IS11SD040001	IS11SD050001	IS11SD060001	IS11SD070001
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Volatile Organic Compounds (UG/KG)							
1,1,1-Trichloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,1,2,2-Tetrachloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,1,2-Trichloro-1,2,2- trifluoroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,1,2-Trichloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,1-Dichloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,1-Dichloroethene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2,4-Trichlorobenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2-Dibromo-3-chloropropane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2-Dibromoethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2-Dichlorobenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2-Dichloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,2-Dichloroethene (total)	14 U	NA	NA	NA	NA	NA	28 U
1,2-Dichloropropane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,3-Dichlorobenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
1,4-Dichlorobenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
2-Butanone	14 J	13 U	13 U	13 U	17 J	24 J	42 J
2-Hexanone	14 U	13 U	13 U	13 U	26 U	21 U	28 U
4-Methyl-2-pentanone	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Acetone	8.7 B	13 U	13 U	13 U	82 J	110 J	130 J
Benzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Bromodichloromethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Bromoform	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Bromomethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Carbon disulfide	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Carbon tetrachloride	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Chlorobenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Chloroethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Chloroform	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Chloromethane	14 J	13 U	13 U	13 U	12 J	10 J	28 U
Cumene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Cyclohexane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Dibromochloromethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Dichlorodifluoromethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Ethylbenzene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Methyl acetate	14 U	13 U	13 U	13 U	26 U	21 U	28 U

Table B-3
Analytical Results for Site 11 Sediment Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SD01	IS11SD02	IS11SD03	IS11SD04	IS11SD05	IS11SD06	IS11SD07
Sample ID	IS11SD010001	IS11SD020001	IS11SD030001	IS11SD040001	IS11SD050001	IS11SD060001	IS11SD070001
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Methyl-tert-butyl ether (MTBE)	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Methylcyclohexane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Methylene chloride	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Styrene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Tetrachloroethene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Toluene	14 U	13 U	13 U	13 U	5.5 J	21 U	28 U
Trichloroethene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Trichlorofluoromethane	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Vinyl chloride	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Xylene, total	14 U	13 U	13 U	13 U	26 U	21 U	28 U
cis-1,2-Dichloroethene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
cis-1,3-Dichloropropene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
trans-1,2-Dichloroethene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
trans-1,3-Dichloropropene	14 U	13 U	13 U	13 U	26 U	21 U	28 U
Semi-volatile Organic Compounds (UG/KG)							
1,1-Biphenyl	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2,2'-Oxybis(1-chloropropane)	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2,4,5-Trichlorophenol	1,100 U	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
2,4,6-Trichlorophenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2,4-Dichlorophenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2,4-Dimethylphenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2,4-Dinitrophenol	1,100 U	1,100 R	1,100 R	1,100 R	2,100 R	1,700 R	2,400 U
2-Chloronaphthalene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2-Chlorophenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2-Methylnaphthalene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2-Methylphenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
2-Nitroaniline	1,100 U	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
2-Nitrophenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
3,3'-Dichlorobenzidine	450 U	440 U	420 U	420 U	850 U	680 U	940 U
3-Nitroaniline	1,100 U	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
4,6-Dinitro-2-methylphenol	1,100 R	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
4-Bromophenyl-phenylether	450 U	440 U	420 U	420 U	850 U	680 U	940 U
4-Chloro-3-methylphenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
4-Chloroaniline	450 U	440 U	420 U	420 U	850 U	680 U	940 U
4-Chlorophenyl-phenylether	450 U	440 U	420 U	420 U	850 U	680 U	940 U
4-Methylphenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U

Table B-3
Analytical Results for Site 11 Sediment Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SD01	IS11SD02	IS11SD03	IS11SD04	IS11SD05	IS11SD06	IS11SD07
Sample ID	IS11SD010001	IS11SD020001	IS11SD030001	IS11SD040001	IS11SD050001	IS11SD060001	IS11SD070001
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
4-Nitroaniline	1,100 U	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
4-Nitrophenol	1,100 U	1,100 U	1,100 U	1,100 U	2,100 U	1,700 U	2,400 U
Acenaphthene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Acenaphthylene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Acetophenone	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Anthracene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Atrazine	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Benzaldehyde	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Benzo(a)anthracene	450 U	250 J	420 U	420 U	850 U	91 J	940 U
Benzo(a)pyrene	450 U	77 J	420 U	420 U	850 U	680 U	940 U
Benzo(b)fluoranthene	450 U	400 J	51 J	420 U	850 U	130 J	940 U
Benzo(g,h,i)perylene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Benzo(k)fluoranthene	450 U	170 J	420 U	420 U	850 U	680 U	940 U
Butylbenzylphthalate	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Caprolactam	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Carbazole	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Chrysene	450 U	370 J	46 J	420 U	850 U	110 J	940 U
Di-n-butylphthalate	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Di-n-octylphthalate	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Dibenz(a,h)anthracene	450 U	55 J	420 U	420 U	850 U	680 U	940 U
Dibenzofuran	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Diethylphthalate	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Dimethyl phthalate	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Fluoranthene	450 U	300 J	56 J	420 U	850 U	200 J	110 J
Fluorene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Hexachlorobenzene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Hexachlorobutadiene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Hexachlorocyclopentadiene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Hexachloroethane	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Indeno(1,2,3-cd)pyrene	450 U	92 J	420 U	420 U	850 U	680 U	940 U
Isophorone	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Naphthalene	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Pentachlorophenol	1,100 U	1,100 U	1,000 U	1,000 U	2,100 U	1,600 U	2,300 U
Phenanthrene	450 U	79 J	420 U	420 U	850 U	74 J	940 U
Phenol	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Pyrene	450 U	240 J	48 J	420 U	850 U	99 J	140 J
bis(2-Chloroethoxy)methane	450 U	440 U	420 U	420 U	850 U	680 U	940 U

Table B-3
Analytical Results for Site 11 Sediment Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SD01	IS11SD02	IS11SD03	IS11SD04	IS11SD05	IS11SD06	IS11SD07
Sample ID	IS11SD010001	IS11SD020001	IS11SD030001	IS11SD040001	IS11SD050001	IS11SD060001	IS11SD070001
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
bis(2-Chloroethyl)ether	450 U	440 U	420 U	420 U	850 U	680 U	940 U
bis(2-Ethylhexyl)phthalate	450 U	440 U	150 J	67 J	120 J	110 J	940 U
n-Nitroso-di-n-propylamine	450 U	440 U	420 U	420 U	850 U	680 U	940 U
n-Nitrosodiphenylamine	450 U	440 U	420 U	420 U	850 U	680 U	940 U
Explosives (UG/KG)							
1,3,5-Trinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
1,3-Dinitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-Trinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,6-Dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Amino-4,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2-Nitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
3-Nitrotoluene	180 J	250 U	250 U	250 U	250 U	150 J	250 U
4-Amino-2,6-dinitrotoluene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
4-Nitrotoluene	250 U	250 U	250 U	140 J	250 U	160 J	250 U
Ammonium perchlorate	130 U	230 U	110 U	100 U	150 U	160 U	220 U
HMX	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Nitrobenzene	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Nitroglycerin	1,200 U	1,200 U	1,300 U	1,200 U	2,600 U	2,100 U	3,000 U
Nitroguanidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PETN	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
RDX	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Tetryl	650 U	650 U	650 U	650 U	650 U	650 U	650 U
Total Metals (MG/KG)							
Aluminum	8,230	2,450	3,740	1,900	9,720	8,940	11,100
Antimony	22.8 L	63.9 L	33.6 L	34.4 L	3.3 L	1.8 UL	2.4 UL
Arsenic	6.7 J	15.2 J	24.5 J	18.9 J	6.5 J	7.7 J	11.8 J
Barium	169	86.4	50.4 J	112	111	89.4	140
Beryllium	0.055 U	0.095 B	0.058 B	0.072 B	0.52 B	0.44 B	0.76 B
Cadmium	1.2 L	4.5 L	6.5 L	4.9 L	1.9 L	1.3 L	4.2 L
Calcium	3,610 J	22,100 J	632 J	1,070 J	2,250 J	3,320 J	3,510 J
Chromium	14.2 L	57.2 L	28.8 L	69.7 L	22.6 L	16.6 L	28.9 L
Cobalt	5.1 B	6.3 J	7.4 J	14	12.7 J	10.9 J	16.8 J
Copper	757 L	149 L	343 L	650 L	83.1 L	50.3 L	222 J
Cyanide	2.7 U	2.6 U	2.6 U	0.12 J	5.1 U	4.1 U	5.7 U

Table B-3
Analytical Results for Site 11 Sediment Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SD01	IS11SD02	IS11SD03	IS11SD04	IS11SD05	IS11SD06	IS11SD07
Sample ID	IS11SD010001	IS11SD020001	IS11SD030001	IS11SD040001	IS11SD050001	IS11SD060001	IS11SD070001
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Iron	23,100 J	8,360 J	134,000 J	129,000 J	32,900 J	28,800 J	41,800 J
Lead	76,400 J	1,160 J	375 J	1,000 J	113 J	53.2 J	272 J
Magnesium	2,660 J	3,190 J	717 J	688 J	1,840 J	1,370 J	1,700 J
Manganese	330 J	637 J	432 J	940 J	517 J	302 J	430 J
Mercury	0.2	0.081 J	0.53	0.11 J	0.19 J	0.17 J	0.36
Nickel	14.6 L	45.1 L	29.5 L	46.4 L	20.8 L	16.6 L	33.2 L
Potassium	454 J	182 J	164 J	131 J	780 J	673 J	1,070 J
Selenium	1.2 UL	1.1 UL	1.7 L	2.2 UL	2.2 UL	1.8 UL	2.4 UL
Silver	8.7	0.82 U	10.9	7.5	3.8 J	1.5 J	2.8 J
Sodium	428 B	332 B	226 B	378 B	638 B	603 B	807 B
Thallium	4.2	1.4 U	1.5 J	2.7 U	2.7 U	2.2 U	3 U
Vanadium	22.1	16.1	12.9	14.1 J	29	26.7	43.4
Zinc	1,310 J	847 J	898 J	1,910 J	258 J	147 J	800 J
Wet Chemistry (MG/KG)							
% Moisture	26.6	24.3	22.1	21.2	61.1	51.5	64.8
Total Petroleum Hydrocarbons (MG/KG)							
TPH-diesel range	4.1 U	13	26	15	69	11	13
TPH-gas range	0.14 U	0.13 U	0.13 U	0.13 U	0.26 U	0.21 U	0.28 U

Notes:

NA - Not analyzed.

B - Result is not significantly greater than that detected in an associated blank.

J - Analyte was detected, but the reported result may be inaccurate or imprecise.

K - Analyte was detected, but the reported result may be biased high.

L - Analyte was detected, but the reported result may be biased low.

R - Rejected. Unreliable result.

U - Not detected greater than the reported detection limit.

UJ - Not detected. The reported detection limit is estimated.

UL - Not detected. The detection limit may be higher than reported.

Table B-4
Analytical results for Site 11 Surface Water Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Volatile Organic Compounds (UG/L)							
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2- trifluoroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromoethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Cumene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	1 J	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	10 U	10 U	10 U	10 U	1.7 B	1.9 B	1.9 B
Styrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table B-4
Analytical results for Site 11 Surface Water Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Tetrachloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichlorofluoromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Xylene, total	10 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)							
1,1-Biphenyl	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	10 R	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	10 R	NA
2,2'-Oxybis(1-chloropropane)	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 R	10 U	10 U	10 U	10 U	10 R	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetophenone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table B-4
Analytical results for Site 11 Surface Water Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Atrazine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzaldehyde	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Caprolactam	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dimethyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	NA	NA	NA	NA	NA	NA
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	1 J	10 U	10 U	10 U	10 U	10 U	10 U
n-Nitroso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
n-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Explosives (UG/L)							
1,3,5-Trinitrobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dinitrobenzene	0.075 J	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,6-Trinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

Table B-4
Analytical results for Site 11 Surface Water Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
2,4-Dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,6-Dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Amino-4,6-dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Nitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
3-Nitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-Amino-2,6-dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-Nitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Ammonium perchlorate	4 U	1.6 J	2.9 J	3.6 J	4 U	4 U	4 U
HMX	0.5 U	0.5 U	0.5 U	0.5 U	0.4 J	0.41 J	0.5 U
Nitrobenzene	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nitroglycerin	30 U	30 U	30 U	30 U	30 U	30 U	30 U
Nitroguanidine	20 U	20 U	20 U	20 U	20 U	20 U	20 U
PETN	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
RDX	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetryl	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Total Metals (UG/L)							
Aluminum	457	239	276	366	995	694	909
Antimony	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Arsenic	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Barium	29 J	24 J	24.7 J	26 J	59.1 J	54.2 J	65.5 J
Beryllium	0.2 U	0.2 U	0.35 B	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	11,500	10,400	10,700	10,100	18,000	16,800	18,100
Chromium	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U
Copper	4.3 B	1.9 U	4.2 J	5.2 J	10.6 J	7.3 J	7.1 J
Cyanide	1.6 B	4.9 B	1.5 B	1.5 B	2.2 B	1.4 B	1.5 B
Iron	772	475	564	726	3,180	2,410	3,100
Lead	38.4	1.6 J	1.3 J	6.1	5.1	2.6 J	2.4 J
Magnesium	5,920	5,380	5,360	5,190	4,390 J	3,760 J	3,960 J
Manganese	127	98.3	103	111	134	95.3	117
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	3.5 B	2.6 B	2.6 B	3.1 B	8 B	5.2 B	7.6 B
Potassium	2,950 J	2,670 J	2,630 J	2,650 J	2,250 J	2,090 J	2,250 J
Selenium	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Silver	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U
Sodium	13,300	12,200	12,000	11,900	20,000	16,700	16,800
Thallium	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U
Vanadium	2 J	1.5 J	1.5 J	2.1 B	3.8 J	3.4 J	3.4 J
Zinc	42.3 B	10.8 B	18.5 B	53.5 B	36.9 B	12.6 B	19.8 B

Table B-4
Analytical results for Site 11 Surface Water Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample ID	IS11SW01	IS11SW02	IS11SW03	IS11SW04	IS11SW05	IS11SW06	IS11SW07
Sample Date	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00	07/20/00
Chemical Name							
Dissolved Metals (UG/L)							
Aluminum	31.6 B	23.1 B	32.5 B	22.3 B	123 B	39.3 B	18.8 U
Antimony	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Arsenic	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Barium	23.6 J	21.2 J	22 J	22.9 J	46.9 J	53.2 J	55.7 J
Beryllium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.54 B
Cadmium	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	12,000	11,600	11,900	11,400	16,800	18,400	16,900
Chromium	4.4 B	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U	2.2 U
Copper	1.9 U	1.9 U	2.4 J	1.9 U	5 J	3.5 J	5.9 J
Iron	47.3 B	27.3 U	32.3 B	34 B	613	229	186
Lead	1.3	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
Magnesium	6,050 B	5,960 B	5,980	5,910	4,130 J	4,070 J	3,600 J
Manganese	4.5 J	2.2 J	3.6 B	2.5 B	83	88.6	74.5
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	5.3 B	3.7 B	2.2 B	1.9 U	9 B	6.6 B	3.6 B
Potassium	2,940 J	2,910 J	2,870 J	2,910 J	2,080 J	2,250 J	2,010 J
Selenium	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Silver	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U
Sodium	13,900	14,000	13,900	14,300	19,200	18,400	16,600
Thallium	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U
Vanadium	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Zinc	33.8 B	24 B	15.2 B	7.2 B	12.7 B	8.6 B	11.6 B
Total Petroleum Hydrocarbons (UG/L)							
TPH-diesel range	160	160	100	120	100 U	100 U	100 U
TPH-gas range	100 U	100 U	100 U	100 U	100 U	100 U	100 U

Notes:
NA - Not analyzed.
B - Result is not significantly greater than that detected in an associated blank.
J - Analyte was detected, but the reported result may be inaccurate or imprecise.
K - Analyte was detected, but the reported result may be biased high.
L - Analyte was detected, but the reported result may be biased low.
R - Rejected. Unreliable result.
U - Not detected greater than the reported detection limit.
UJ - Not detected. The reported detection limit is estimated.
UL - Not detected. The detection limit may be higher than reported.

Table B-5
Analytical results for Site 11 Waste Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11WS01	IS11WS02
Sample ID	IS11WS010204	IS11WS020204
Sample Date	08/09/00	08/09/00
Chemical Name		
Volatile Organic Compounds (UG/KG)		
1,1,1-Trichloroethane	11 U	11 U
1,1,2,2-Tetrachloroethane	11 U	11 U
1,1,2-Trichloro-1,2,2- trifluoroethane	11 U	11 U
1,1,2-Trichloroethane	11 U	11 U
1,1-Dichloroethane	11 U	11 U
1,1-Dichloroethene	11 U	11 U
1,2,4-Trichlorobenzene	11 U	11 U
1,2-Dibromo-3-chloropropane	11 U	11 U
1,2-Dibromoethane	11 U	11 U
1,2-Dichlorobenzene	11 U	11 U
1,2-Dichloroethane	11 U	11 U
1,2-Dichloropropane	11 U	11 U
1,3-Dichlorobenzene	11 U	11 U
1,4-Dichlorobenzene	11 U	11 U
2-Butanone	2 J	17
2-Hexanone	11 U	11 U
4-Methyl-2-pentanone	11 U	11 U
Acetone	18 B	84
Benzene	11 U	2.1 J
Bromodichloromethane	11 U	11 U
Bromoform	11 U	11 U
Bromomethane	11 U	11 U
Carbon disulfide	11 U	5.4 J
Carbon tetrachloride	11 U	11 U
Chlorobenzene	11 U	11 U
Chloroethane	11 U	11 U
Chloroform	11 U	11 U
Chloromethane	11 U	11 U
Cumene	11 U	11 U
Cyclohexane	11 U	13
Dibromochloromethane	11 U	11 U
Dichlorodifluoromethane	11 U	11 U
Ethylbenzene	11 U	5.2 J
Methyl acetate	11 U	11 U
Methyl-tert-butyl ether (MTBE)	11 U	11 U
Methylcyclohexane	11 U	11 U
Methylene chloride	11 U	2.8 B
Styrene	11 U	11 U
Tetrachloroethene	11 U	11 U
Toluene	11 U	7.3 J
Trichloroethene	11 U	24
Trichlorofluoromethane	11 U	11 U
Vinyl chloride	11 U	7.3 J
Xylene, total	11 U	29
cis-1,2-Dichloroethene	11 U	35
cis-1,3-Dichloropropene	11 U	11 U
trans-1,2-Dichloroethene	11 U	11 U
trans-1,3-Dichloropropene	11 U	11 U
Semi-volatile Organic Compounds (UG/KG)		
1,1-Biphenyl	370 U	360 U
2,2'-Oxybis(1-chloropropane)	370 U	360 U
2,4,5-Trichlorophenol	940 U	910 U
2,4,6-Trichlorophenol	370 U	360 U
2,4-Dichlorophenol	370 U	360 U
2,4-Dimethylphenol	370 U	360 U
2,4-Dinitrophenol	940 U	910 U
2-Chloronaphthalene	370 U	360 U
2-Chlorophenol	370 U	360 U
2-Methylnaphthalene	370 U	200 B
2-Methylphenol	370 U	360 U
2-Nitroaniline	940 U	910 U
2-Nitrophenol	370 U	360 U

Table B-5
Analytical results for Site 11 Waste Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11WS01	IS11WS02
Sample ID	IS11WS010204	IS11WS020204
Sample Date	08/09/00	08/09/00
Chemical Name		
3,3'-Dichlorobenzidine	370 U	360 U
3-Nitroaniline	940 U	910 U
4,6-Dinitro-2-methylphenol	940 U	910 U
4-Bromophenyl-phenylether	370 U	360 U
4-Chloro-3-methylphenol	370 U	360 U
4-Chloroaniline	370 U	360 U
4-Chlorophenyl-phenylether	370 U	360 U
4-Methylphenol	370 U	59 J
4-Nitroaniline	940 U	910 U
4-Nitrophenol	940 U	910 U
Acenaphthene	370 U	52 J
Acenaphthylene	370 U	360 U
Acetophenone	370 U	64 J
Anthracene	370 U	86 J
Atrazine	370 U	360 U
Benzaldehyde	370 U	360 U
Benzo(a)anthracene	99 J	430
Benzo(a)pyrene	370 U	110 J
Benzo(b)fluoranthene	86 J	570
Benzo(g,h,i)perylene	370 U	360 U
Benzo(k)fluoranthene	45 J	260 J
Butylbenzylphthalate	370 U	360 U
Caprolactam	370 U	360 U
Carbazole	370 U	40 J
Chrysene	100 J	460
Di-n-butylphthalate	370 U	38 J
Di-n-octylphthalate	370 U	360 U
Dibenz(a,h)anthracene	370 U	360 U
Dibenzofuran	370 U	360 U
Diethylphthalate	140 J	120 J
Dimethyl phthalate	370 U	360 U
Fluoranthene	170 J	750
Fluorene	370 U	60 J
Hexachlorobenzene	370 U	360 U
Hexachlorobutadiene	370 U	360 U
Hexachlorocyclopentadiene	370 U	360 U
Hexachloroethane	370 U	360 U
Indeno(1,2,3-cd)pyrene	370 U	100 J
Isophorone	370 U	360 U
Naphthalene	370 U	160 J
Pentachlorophenol	900 U	880 U
Phenanthrene	84 J	460
Phenol	370 U	64 J
Pyrene	72 J	430
bis(2-Chloroethoxy)methane	370 U	360 U
bis(2-Chloroethyl)ether	370 U	360 U
bis(2-Ethylhexyl)phthalate	28,000	14,000
n-Nitroso-di-n-propylamine	370 U	360 U
n-Nitrosodiphenylamine	370 U	360 U
Explosives (UG/KG)		
1,3,5-Trinitrobenzene	250 UL	250 UL
1,3-Dinitrobenzene	250 UL	250 UL
2,4,6-Trinitrotoluene	250 UL	250 UL
2,4-Dinitrotoluene	250 UL	250 UL
2,6-Dinitrotoluene	420 L	120 L
2-Amino-4,6-dinitrotoluene	250 UL	250 U
2-Nitrotoluene	250 UL	250 UL
3-Nitrotoluene	250 UL	250 UL
4-Amino-2,6-dinitrotoluene	250 UL	250 UL
4-Nitrotoluene	250 UL	250 U
Ammonium perchlorate	1,200	100 U
HMX	360 L	480 L
Nitrobenzene	250 UL	250 UL
Nitroglycerin	1,300 UL	1,300 U

Table B-5
Analytical results for Site 11 Waste Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11WS01	IS11WS02
Sample ID	IS11WS010204	IS11WS020204
Sample Date	08/09/00	08/09/00
Chemical Name		
Nitroguanidine	100 UL	100 UL
PETN	2,500 UL	2,500 UL
RDX	500 UL	280 L
Tetryl	650 UL	650 UL
Total Metals (MG/KG)		
Aluminum	3,580 J	24,100 J
Antimony	0.97 UL	13.6 L
Arsenic	3 L	17.1 L
Barium	79.6	147
Beryllium	0.065 B	0.044
Cadmium	6.5	139
Calcium	1,440	10,400
Chromium	7.6	212
Cobalt	3.3 J	17.2
Copper	28.4	1,270
Cyanide	0.56	0.19 J
Iron	6,530	76,000
Lead	79.2	4,200
Magnesium	630 J	4,800
Manganese	83.2	500
Mercury	45.9 L	0.85 L
Nickel	6.6 J	107
Potassium	319 J	803 J
Selenium	0.97 U	1.9
Silver	3.4	23.8
Sodium	106 J	847 J
Thallium	1.2	1.2
Vanadium	9.4 J	73.5
Zinc	304 J	4,110 J
Wet Chemistry (MG/KG)		
% Moisture	11.4	9
Total Petroleum Hydrocarbons (MG/KG)		
TPH-diesel range	92	450
TPH-gas range	0.52	0.27

Notes:
NA - Not analyzed.
B - Result is not significantly greater than that detected in an associated blank.
J - Analyte was detected, but the reported result may be inaccurate or imprecise.
K - Analyte was detected, but the reported result may be biased high.
L - Analyte was detected, but the reported result may be biased low.
R - Rejected. Unreliable result.
U - Not detected greater than the reported detection limit.
UJ - Not detected. The reported detection limit is estimated.
UL - Not detected. The detection limit may be higher than reported.

Table B-6
Analytical Results for Direct Push Groundwater Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11GW01	IS11GW02	IS11GW03	IS11GW04	IS11GW05	IS11GW06
Sample ID	IS11GW010700	IS11GW020700	IS11GW030700	IS11GW040700	IS11GW050700	IS11GW060700
Sample Date	07/24/00	07/25/00	07/25/00	07/25/00	07/25/00	07/25/00
Chemical Name						
Volatile Organic Compounds (UG/L)						
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2- trifluoroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromoethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	10 U	3 B	2.5 B	3.7 B	2.4 B	3.2 B
Benzene	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	10 U	12	10 U
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Cumene	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	10 U	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	10 U	10 U	10 U	10 U	10 U	10 U
Methyl-tert-butyl ether (MTBE)	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	1.7 J	10 U	10 U	10 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	1.5 J	1.7 J	10 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
Trichlorofluoromethane	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	10 U	10 U	10 U	10 U
Xylene, total	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)						
1,1-Biphenyl	10 U	10 UJ	10 U	10 U	200 U	10 U
2,2'-Oxybis(1-chloropropane)	10 U	10 UJ	10 U	10 U	200 U	10 U
2,4,5-Trichlorophenol	25 U	25 UJ	25 U	25 U	500 U	25 U
2,4,6-Trichlorophenol	10 U	10 UJ	10 U	10 U	200 U	10 U
2,4-Dichlorophenol	10 U	10 UJ	10 U	10 U	200 U	10 U
2,4-Dimethylphenol	10 U	10 UJ	10 U	10 U	200 U	10 U
2,4-Dinitrophenol	25 UJ	25 UJ	25 UJ	25 UJ	500 U	25 UJ
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	10 UJ
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	10 UJ
2-Chloronaphthalene	10 U	10 UJ	10 U	10 U	200 U	10 U
2-Chlorophenol	10 U	10 UJ	10 U	10 U	200 U	10 U
2-Methylnaphthalene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
2-Methylphenol	10 U	10 UJ	10 U	10 U	200 U	10 UJ
2-Nitroaniline	25 U	25 UJ	25 U	25 U	500 U	25 UJ
2-Nitrophenol	10 U	10 UJ	10 U	10 U	200 U	10 UJ
3,3'-Dichlorobenzidine	10 U	10 UJ	10 U	10 U	200 U	10 U
3-Nitroaniline	25 U	25 UJ	25 U	25 U	500 U	25 UJ

Table B-6
Analytical Results for Direct Push Groundwater Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11GW01	IS11GW02	IS11GW03	IS11GW04	IS11GW05	IS11GW06
Sample ID	IS11GW010700	IS11GW020700	IS11GW030700	IS11GW040700	IS11GW050700	IS11GW060700
Sample Date	07/24/00	07/25/00	07/25/00	07/25/00	07/25/00	07/25/00
Chemical Name						
4,6-Dinitro-2-methylphenol	25 UJ	25 UJ	25 UJ	25 U	500 U	25 U
4-Bromophenyl-phenylether	10 U	10 UJ	10 U	10 U	200 U	10 U
4-Chloro-3-methylphenol	10 U	10 UJ	10 U	10 U	200 U	10 U
4-Chloroaniline	10 U	10 UJ	10 U	10 U	200 U	10 U
4-Chlorophenyl-phenylether	10 U	10 UJ	10 U	10 U	200 U	10 U
4-Methylphenol	7 J	4 J	10 U	10 U	200 U	10 UJ
4-Nitroaniline	25 U	25 UJ	25 U	25 U	500 U	25 UJ
4-Nitrophenol	25 U	25 UJ	25 U	25 U	500 U	25 UJ
Acenaphthene	10 U	10 UJ	10 U	10 U	200 U	10 U
Acenaphthylene	10 U	10 UJ	10 U	10 U	200 U	10 U
Acetophenone	10 U	10 UJ	10 U	10 U	200 U	10 U
Anthracene	10 U	10 UJ	10 U	10 U	200 U	10 U
Atrazine	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzaldehyde	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzo(a)anthracene	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzo(a)pyrene	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzo(b)fluoranthene	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzo(g,h,i)perylene	10 U	10 UJ	10 U	10 U	200 U	10 U
Benzo(k)fluoranthene	10 U	10 UJ	10 U	10 U	200 U	10 U
Butylbenzylphthalate	10 U	10 UJ	10 U	10 U	200 U	10 U
Caprolactam	10 U	10 UJ	10 U	10 U	200 U	10 U
Carbazole	10 U	10 UJ	10 U	10 U	200 U	10 U
Chrysene	10 U	10 UJ	10 U	10 U	200 U	10 U
Di-n-butylphthalate	10 U	10 UJ	10 U	10 U	200 U	10 U
Di-n-octylphthalate	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Dibenz(a,h)anthracene	10 U	10 UJ	10 U	10 U	200 U	10 U
Dibenzofuran	10 U	10 UJ	10 U	10 U	200 U	10 U
Diethylphthalate	10 U	10 UJ	3 J	10 U	200 U	2 U
Dimethyl phthalate	10 U	10 UJ	10 U	10 U	200 U	10 U
Fluoranthene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Fluorene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Hexachlorobenzene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Hexachlorobutadiene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Hexachlorocyclopentadiene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Hexachloroethane	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Indeno(1,2,3-cd)pyrene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Isophorone	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Naphthalene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Nitrobenzene	10 U	10 UJ	10 U	10 U	200 U	10 UJ
Pentachlorophenol	25 U	25 UJ	25 U	25 U	500 U	25 U
Phenanthrene	10 U	10 UJ	10 U	10 U	200 U	10 U
Phenol	10 U	5 J	10 U	10 U	200 U	10 U
Pyrene	10 U	10 UJ	10 U	10 U	200 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 UJ	10 U	10 U	200 U	10 U
bis(2-Chloroethyl)ether	10 U	10 UJ	10 U	10 U	200 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	2 B	3 B	3 B	1,100	310
n-Nitroso-di-n-propylamine	10 U	10 UJ	10 U	10 U	200 U	10 U
n-Nitrosodiphenylamine	10 U	10 UJ	2 J	10 U	200 U	10 U
Explosives (UG/L)						
1,3,5-Trinitrobenzene	0.2 U	0.45 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dinitrobenzene	0.1 J	0.2 U	0.2 U	0.044 J	0.2 U	0.2 U
2,4,6-Trinitrotoluene	0.2 U	4.1 K	0.2 U	0.2 U	0.2 U	0.11 J
2,4-Dinitrotoluene	0.2 U	6.2 K	0.2 U	0.068 J	0.22	NA
2,6-Dinitrotoluene	0.2 U	2.7 K	0.2 U	0.2 U	0.13 J	NA
2-Amino-4,6-dinitrotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Nitrotoluene	0.2 U	1.7 K	0.14 J	0.2 U	1.7 U	1.4 U
3-Nitrotoluene	0.2 U	0.32 K	0.2 U	0.2 U	0.2 U	0.2 R
4-Amino-2,6-dinitrotoluene	0.2 U	0.2 U	0.2 U	0.1 J	0.2 U	0.2 U
4-Nitrotoluene	0.2 U	1.5	0.39	0.2 U	1.5 U	1 U
Ammonium perchlorate	4 U	4 U	4 U	4 U	0.25 J	4 U
HMX	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Nitrobenzene	0.2 U	0.2 U	0.13 J	0.077 J	0.2 U	0.2 U
Nitroglycerin	30 U	30 U	30 U	30 U	30 U	30 U
Nitroguanidine	20 U	20 U	20 U	20 U	20 U	20 U
PETN	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
RDX	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetryl	0.2 U	0.2 U	0.2 U	0.068 J	0.2 U	0.2 U
Total Metals (UG/L)						

Table B-6
Analytical Results for Direct Push Groundwater Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11GW01	IS11GW02	IS11GW03	IS11GW04	IS11GW05	IS11GW06
Sample ID	IS11GW010700	IS11GW020700	IS11GW030700	IS11GW040700	IS11GW050700	IS11GW060700
Sample Date	07/24/00	07/25/00	07/25/00	07/25/00	07/25/00	07/25/00
Chemical Name						
Aluminum	80,900	38,200	15,700	6,300	2,930	3,250
Antimony	6.7 L	6.1 L	254 L	15.6 L	4.3 U	82.7
Arsenic	44.4 J	39.7	24.5	10.3	3.6 U	9.4 J
Barium	647 J	1,980	7,900	1,650	2,200	1,520
Beryllium	3.6 B	10.3	0.2 U	0.31 B	0.2 U	0.2 U
Cadmium	2.2 B	3 J	27.1	9.2	1.7 B	10.5
Calcium	37,600	186,000	226,000	46,800	76,800	65,100
Chromium	91.3	94.8	97.5	19.2	11.8	14.4
Cobalt	56.3 J	83.2	31 J	6.2 J	6 J	3.8 J
Copper	105	56.8	802	133	6.8 J	238
Cyanide	1.3 B	1.2	1.8	10 U	2.8	5.7
Iron	125,000	211,000	165,000	26,500	84,000	23,100
Lead	288	222	4,170	684	157	673
Magnesium	17,300	120,000	60,500	38,000	38,000	44,600
Manganese	2,710	7,460	3,980	349	884	456
Mercury	0.81	107	8.3	0.35	0.18 J	1.1
Nickel	69.9	120	124	18.6 J	29.4 J	25.7 J
Potassium	10,400	20,200	59,700	32,300	30,700	40,900
Selenium	4.3 U	5.3	4.3 U	4.3 U	4.3 U	4.3 U
Silver	7.5 J	16.3	170	10.4	4.7 J	50.8
Sodium	25,000	45,000	108,000	104,000	100,000	113,000
Thallium	9.4 J	16.5	9 J	5.3 U	7.8 J	5.3 U
Vanadium	141	226	39.7 J	33.1 J	5.5 J	10.6 J
Zinc	412 J	767 J	13,900 J	1,240	1,500 J	1,090
Dissolved Metals (UG/L)						
Aluminum	160 B	82.4 B	25.1 B	26.5 B	18.8 U	18.8 U
Antimony	4.3 U	4.3 U	14.2 B	4.3 U	4.3 U	55.1 J
Arsenic	8.7 J	3.6 U	4.9 J	3.6 U	4.2 J	3.6 U
Barium	133 J	208	2,510	1,600	1,770	1,190
Beryllium	0.2 U	0.23 B	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	35,800	69,400	55,900	46,900	58,600	53,100
Chromium	2 U	2 U	2 U	2 U	2 U	2 U
Cobalt	3.8 J	2.5 J	2.2 U	2.2 U	2.2 U	2.2 U
Copper	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	4.7 J
Iron	24,300	33,600	7,610	2,010	16,700	96.6 B
Lead	1.3 U	1.3 U	4.6	1.3 U	1.3 U	3.5
Magnesium	11,500	29,200	35,000	39,200	34,300	44,600
Manganese	2,230	2,450	282	110	125	210
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	4.1 J	4.4 J	3.2 J	1.9 J	2.7 J	8.7 J
Potassium	6,100	8,070	45,100	33,000	28,000	41,600
Selenium	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	4.3 U
Silver	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U
Sodium	27,800	32,700	94,600	106,000	97,700	121,000
Thallium	5.3 U	5.3 U	5.3 U	5.3 U	5.3 J	5.3 U
Vanadium	2.3 J	1.4 U	1.4 U	1.4 U	1.4 J	1.4 U
Zinc	19.1	11.5 B	72.6	17.1 B	26.5 J	42.4
Total Petroleum Hydrocarbons (UG/L)						
TPH-diesel range	310	530	1,400	190	770	1,200
TPH-gas range	100 U	100 U	100 U	100 U	100 U	100 U

Notes:
NA - Not analyzed.
B - Result is not significantly greater than that detected in an associated blank.
J - Analyte was detected, but the reported result may be inaccurate or imprecise.
K - Analyte was detected, but the reported result may be biased high.
L - Analyte was detected, but the reported result may be biased low.
R - Rejected. Unreliable result.
U - Not detected greater than the reported detection limit.
UJ - Not detected. The reported detection limit is estimated.
UL - Not detected. The detection limit may be higher than reported.

Table B-7
Analytical Results for Groundwater Monitoring Well Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11MW01	IS11MW02	IS11MW03		IS11MW04	IS11MW05
Sample ID	IS11MW010900	IS11MW020900	IS11MW030900	IS11MW030900P	IS11MW040900	IS11MW050900
Sample Date	09/11/00	09/11/00	09/11/00	09/11/00	09/11/00	09/08/00
Chemical Name						
Volatile Organic Compounds (UG/L)						
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	4.5 J	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloro-1,2,2- trifluoroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	3.8 J	10 U
1,1-Dichloroethene	10 U	10 U	10 U	10 U	2.6 J	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dibromo-3-chloropropane	10 R	10 R	10 R	10 R	10 R	10 U
1,2-Dibromoethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene (total)	NA	10 U	NA	NA	NA	NA
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	3.6 B	2.8 B	3.6 B	3.5 B	3.1 B	2.8 B
Benzene	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U
Carbon disulfide	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	3.8 J	10 U	10 U	10 U	10 U	10 U
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Cumene	10 U	10 U	10 U	10 U	10 U	10 U
Cyclohexane	10 U	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorodifluoromethane	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U
Methyl acetate	10 U	10 U	4.4 J	5 J	10 U	10 U
Methyl-tert-butyl ether (MTBE)	10 U	10 U	10 U	10 U	10 U	10 U
Methylcyclohexane	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	2.4 B	2.5 B	2.7 B	3 B	2.5 B	2.8 B
Styrene	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	10 U	10 U	16	18	10 U	10 U
Trichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
Trichlorofluoromethane	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	10 U	10 U	10 U	10 U
Xylene, total	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,2-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
Semi-volatile Organic Compounds (UG/L)						
1,1-Biphenyl	10 U	NA	10 U	10 U	10 U	10 U
2,2'-Oxybis(1-chloropropane)	10 U	NA	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	NA	25 U	25 U	25 U	25 U
2,4,6-Trichlorophenol	10 U	NA	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	NA	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	NA	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	NA	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	NA	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	NA	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	NA	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	NA	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	NA	25 U	25 U	25 U	25 U
2-Nitrophenol	10 U	NA	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	NA	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	NA	25 U	25 U	25 U	25 U

Table B-7
Analytical Results for Groundwater Monitoring Well Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11MW01	IS11MW02	IS11MW03		IS11MW04	IS11MW05
Sample ID	IS11MW010900	IS11MW020900	IS11MW030900	IS11MW030900P	IS11MW040900	IS11MW050900
Sample Date	09/11/00	09/11/00	09/11/00	09/11/00	09/11/00	09/08/00
Chemical Name						
4,6-Dinitro-2-methylphenol	25 U	NA	25 U	25 U	25 U	25 U
4-Bromophenyl-phenylether	10 U	NA	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	NA	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	NA	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	NA	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	NA	23	14	10 U	10 U
4-Nitroaniline	25 U	NA	25 U	25 U	25 U	25 U
4-Nitrophenol	25 U	NA	25 U	25 U	25 U	25 U
Acenaphthene	10 U	NA	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	NA	10 U	10 U	10 U	10 U
Acetophenone	10 U	NA	10 U	10 U	10 U	10 U
Anthracene	10 U	NA	10 U	10 U	10 U	10 U
Atrazine	10 U	NA	10 U	10 U	10 U	10 U
Benzaldehyde	10 U	NA	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	NA	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	NA	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	NA	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	NA	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	NA	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	NA	10 U	10 U	10 U	10 U
Caprolactam	10 U	NA	10 U	10 U	10 U	10 U
Carbazole	10 U	NA	10 U	10 U	10 U	10 U
Chrysene	10 U	NA	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	NA	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10 U	NA	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	NA	10 U	10 U	10 U	10 U
Dibenzofuran	10 U	NA	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	NA	10 U	10 U	10 U	10 U
Dimethyl phthalate	10 U	NA	10 U	10 U	10 U	10 U
Fluoranthene	10 U	NA	10 U	10 U	10 U	10 U
Fluorene	10 U	NA	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	NA	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	NA	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	NA	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	NA	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	NA	10 U	10 U	10 U	10 U
Isophorone	10 U	NA	10 U	10 U	10 U	10 U
Naphthalene	10 U	NA	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	NA	25 U	25 U	25 U	25 U
Phenanthrene	10 U	NA	10 U	10 U	10 U	10 U
Phenol	10 U	NA	10 U	10 U	10 U	10 U
Pyrene	10 U	NA	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	NA	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	NA	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	17 B	NA	10 U	10 U	2 B	2 B
n-Nitroso-di-n-propylamine	10 U	NA	10 U	10 U	10 U	10 U
n-Nitrosodiphenylamine	10 U	NA	10 U	10 U	10 U	10 U
Explosives (UG/L)						
1,3,5-Trinitrobenzene	0.2 U	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,3-Dinitrobenzene	0.064 J	NA	0.2 U	0.2 U	0.2 U	0.066 J
2,4,6-Trinitrotoluene	0.2 U	NA	0.2 U	0.2 U	0.2 U	0.2 U
2,4-Dinitrotoluene	0.2 U	NA	0.2 U	0.16 J	0.2 U	0.2 U
2,6-Dinitrotoluene	0.2 U	NA	0.2 U	0.11 J	0.2 U	0.2 U
2-Amino-4,6-dinitrotoluene	0.2 U	NA	0.2 U	0.2 U	0.2 U	0.2 U
2-Nitrotoluene	0.2 U	NA	0.2 U	0.2 U	0.29 U	0.15 J
3-Nitrotoluene	0.97 U	NA	1.4 U	1.2 U	0.15 J	0.2 U
4-Amino-2,6-dinitrotoluene	0.2 U	NA	0.2 U	0.2 U	0.2 U	0.2 U
4-Nitrotoluene	0.15 J	NA	0.37	0.29	0.2 U	0.2 U
Ammonium perchlorate	4 U	NA	4 U	4 U	4 U	4 U
HMX	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U
Nitrobenzene	0.2 U	NA	0.2 U	0.2 U	0.2 U	0.2 U
Nitroglycerin	30 U	NA	30 U	30 U	30 U	30 U
Nitroguanidine	20 U	NA	20 U	20 U	20 U	20 U
PETN	2.5 U	NA	2.5 U	2.5 U	2.5 U	2.5 U
RDX	0.5 U	NA	0.5 U	0.5 U	0.16 J	0.5 U
Tetryl	0.2 U	NA	0.2 U	0.2 U	0.12 J	0.2 U

Table B-7
Analytical Results for Groundwater Monitoring Well Samples
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

Station ID	IS11MW01	IS11MW02	IS11MW03		IS11MW04	IS11MW05
Sample ID	IS11MW010900	IS11MW020900	IS11MW030900	IS11MW030900P	IS11MW040900	IS11MW050900
Sample Date	09/11/00	09/11/00	09/11/00	09/11/00	09/11/00	09/08/00
Chemical Name						
Total Metals (UG/L)						
Aluminum	1,350	53.6 B	2,180	1,100	31,400	10,700
Antimony	3.7 J	4.2 J	3.1 U	3.1 U	3.1 U	4.3 U
Arsenic	4 J	4.5 J	3.2 U	3.2 U	8.2 J	3.6 U
Barium	1,680	685	237	218	319	319
Beryllium	0.08 U	0.08 U	0.19 B	0.18 B	2.2 B	1.1 J
Cadmium	0.79 B	0.25 U	0.25 U	0.25 U	0.25 U	0.71 J
Calcium	56,400	62,200	85,400	80,800	8,690	6,340 J
Chromium	5.3 J	1.1 J	9.2 J	4.4 J	59.6	37.8
Cobalt	0.83 U	1 J	2.6 J	1.5 J	59.7	17.1 J
Copper	20.7 J	1.4 J	5.1 J	4.1 J	33.9	21.1 J
Cyanide	10.1 L	10 UL	10 UL	10 UL	10 UL	10 UL
Iron	14,000	8,590	37,800	34,800	51,000	15,600
Lead	78.6	14.5	6.1	3.5	20.7	8
Magnesium	35,600	32,300	25,500	22,200	9,700	4,600 J
Manganese	188	2,360	2,570	2,480	928	337 J
Mercury	0.1	0.1	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	4.2 J	2 J	7.3 J	2.9 J	110	61.7
Potassium	30,900	41,200	8,710	8,110	3,350 J	2,190 J
Selenium	4 U	4 U	4 U	4 U	4 U	4.3 U
Silver	6.1 J	1.1 U	2.1 J	1.1 U	1.1 U	3.1 U
Sodium	98,400	81,300	33,400	32,200	43,500	26,100
Thallium	9.8 B	6.8 U	6.8 U	6.8 U	6.8 U	5.3 U
Vanadium	2.2 J	0.76 U	5.3 J	2.9 J	55.4	21 J
Zinc	195	196	39.9	25.7	217	93 J
Dissolved Metals (UG/L)						
Aluminum	67 B	27.7 B	80.4 B	96 B	116 B	1,330
Antimony	3.1 U	5 J	3.1 U	3.1 U	3.1 U	4.3 U
Arsenic	3.2 U	5.1 J	3.2 U	3.2 U	3.2 U	3.6 U
Barium	1,630	792	215	223	138 J	24.5 J
Beryllium	0.08 U	0.08 U	0.15 B	0.18 B	0.61 B	0.2 U
Cadmium	0.25 U	0.25 U	0.25 U	0.25 U	0.62 J	0.47 J
Calcium	54,500	66,000	81,800	84,700	7,550	1,960 J
Chromium	1.1 U	1.2 B	1.1 U	1.7 B	1.1 U	9.2 J
Cobalt	0.83 U	1 J	0.83 U	0.83 U	35 J	3.7 J
Copper	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.9 U
Iron	10,900	9,240	34,200	35,300	76.8 B	2,040
Lead	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.3 U
Magnesium	34,500	33,300	23,100	23,800	6,240	1,290 J
Manganese	165	2,320	2,500	2,590	712	90.3 J
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	2 U	2.6 J	2 U	2 U	58	16.2 J
Potassium	30,100	42,200	8,220	8,590	512 B	578 J
Selenium	4 U	4 U	4 U	4 U	4 U	4.3 U
Silver	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	3.1 U
Sodium	94,800	84,900	31,300	32,700	42,500	29,900
Thallium	8.2 B	6.8 U	6.8 U	6.8 U	6.8 U	5.3 U
Vanadium	0.76 U	0.76 U	1.1 J	1.1 J	0.76 U	2.6 J
Zinc	7.6 B	181	11.9 B	9.8 B	63.3	34.5 J
Total Petroleum Hydrocarbons (UG/L)						
TPH-diesel range	370 B	220 B	300 B	110 B	100 U	100 U
TPH-gas range	100 U	100 U	100 U	100 U	100 U	100 U

Notes:

NA - Not analyzed.

B - Result is not significantly greater than that detected in an associated blank.

J - Analyte was detected, but the reported result may be inaccurate or imprecise.

K - Analyte was detected, but the reported result may be biased high.

L - Analyte was detected, but the reported result may be biased low.

R - Rejected. Unreliable result.

U - Not detected greater than the reported detection limit.

UJ - Not detected. The reported detection limit is estimated.

UL - Not detected. The detection limit may be higher than reported.

Appendix C
Wetland Delineation Technical Memorandum

Wetland Delineation for Site 11, Caffee Road Landfill, Naval District Washington, Indian Head, Indian Head, Maryland

PREPARED FOR: Gunarti Coghlan/CH2M HILL

PREPARED BY: Lindsey Carr/CH2M HILL
Dave DeCaro/CH2M HILL

COPIES: Gene Peters/CH2M HILL
Margaret Kasim/CH2M HILL

DATE: March 11, 2005

1. Introduction

CH2M HILL was asked to identify wetlands and surface water bodies at Project Site defined as portions of Site 11, Caffee Road Landfill, located west and south of Buildings 024 and 024a, to the eastern boundary at Scrap Point Circle and the northern boundary of Caffee Road at the Naval District Washington, Indian Head (NDWIH) in Indian Head, Maryland. This report summarizes the results of wetland delineation activities conducted by CH2M HILL staff scientists in order to determine the extent of capping or excavation in the Project Site including portions of Area A and the upland area of Site 11 (Figure C-1).

On February 10, 2005, field studies, to locate wetlands and water bodies within the Project Site, were initiated and completed. These field surveys were conducted to assist NDWIH in avoiding and/or minimizing, to the greatest extent practicable and feasible, potential impacts to wetlands and water bodies, resulting from future capping or excavation within the Project Site.

2. Methodologies

Wetland delineation were performed in accordance with the routine onsite methodology described in the 1987 U.S. Army Corps of Engineers (ACOE) Manual. Data sheets were prepared in the field, characterizing the resources observed (see attached data sheets). Each data sheet included the vegetation species and stratum (herbaceous, shrub, or tree layer), the presence of wetland hydrology, and soil profiles.

Areas meeting the technical criteria of the ACOE Manual were flagged and surveyed. The locations of the wetland/upland and water body boundaries were marked with pink flags. Upland and wetland points, where datasheets were prepared, were also marked with pink flags. The locations of the flags were logged by CH2M HILL with a Global Positioning System (GPS) Pathfinder® Pro XR backpack unit during the delineation. Flag locations are depicted on the wetland delineation map located at the end of this report (Figure C-1).

Prior to conducting field investigations, existing resource information for the Project Site were reviewed. These included the references listed below, and are also presented in Appendix C.

- Indian Head Quad United States Geological Survey (USGS) Topographic Map (Figure C-1),
- Indian Head Quad National Wetlands Inventory (NWI) Map (Figure C-2),
- Natural Resources Conservation Service (NRCS), Charles County Soils Map
- NRCS Charles County Hydric Soils List

The references were reviewed to develop a preliminary understanding of potential wetlands and water bodies existing on-site. These results were then verified in field during the delineation activities.

3. Wetland Delineation Results

This section presents the results of the wetland and water body delineations performed at the Project Site. Two potential resource areas were identified, Area One (IH-01) and Area Two (IH-02) within the Project Site. IH-01 is located within the far western corner of the Project Site, while IH-02 is located entirely within Area A. No wetlands or water bodies were observed in Area B.

3.1 Tidal and Freshwater Wetlands and Waterbodies

A total of two wetlands were observed and delineated within the Project Site. Area One (IH-01) is classified under the NWI wetland classification scheme as E2EM (Estuarine Intertidal Emergent). The total area encompassed by IH-01 is 1.59 acres, which can be divided into two distinct areas, intertidal and freshwater. This intertidal wetland consists of approximately 0.82 acres and is bordered to the east by approximately 0.77 acres of freshwater Palustrine Emergent (PEM) wetland. The E2EM wetland is located on the western and northwestern limits of the Project Site and is tidally influenced by Mattawoman Creek which discharges to the Potomac River. An unnamed tidal tributary to Turkey Run (unnamed stream one), approximately 244 linear feet runs longitudinally through the E2EM wetland. Unnamed stream one is a perennial stream that is tidally influenced in its lower reaches leading to Mattawoman Creek. The water body is characterized by a well defined shallow channel comprised of fine silts and leaf debris. The approximate channel width ranges from a wide mudflat of approximately 20-30 feet near Mattawoman Creek to a three feet wide channel in its upper reaches near Turkey Run, with an approximate depth ranging from one to five feet deep. An additional unnamed freshwater tributary (unnamed stream two) with a length of 234 linear feet, runs longitudinally through the PEM wetland from north to south. Unnamed stream two is similar to unnamed stream one, as both are perennial with shallow channels composed of fine silts and leaf debris. Unnamed stream two is approximately the same width as unnamed stream one, but differs in bank height. The depth of the unnamed stream two is approximately four feet and consists of mostly sands. Infrequent shallow riffles, composed of woody debris, are evident along the stream channel.

Area Two (IH-02) is a PEM freshwater wetland area, approximately 0.10 acres near the center of the Project Site along Mattawoman Creek. This area serves as a drainage basin for the upper grassy fields and the paved access road. The site also experiences some tidal influence at its mouth along the Northern shore of Mattawoman Creek.

3.2 Area One (IH-01)

This 1.59 acre E2EM wetland is located on the western edge of Project Site. Flags IH-01-01 through IH-01-11 and IH-01-15 through IH-01-27 were placed along the area boundary. The eastern portion of the wetland was observed to be a PEM freshwater wetland system. IH-01 is comprised of freshwater and tidal wetland zones. The total acreage of IH-01 within the Area A site boundary is 0.23 acres.

The E2EM area was observed to be predominantly mudflat with homogeneous areas of cattail. The freshwater wetland zone was dominated by *Carex spp*., and *Juncus sp*., with scatterings of Marsh mallow (*Althea offcinalis*) and Poison ivy (*Rhus toxicodendron*) within the terrestrial fringe. Two stands of low canopy trees are also present within the freshwater wetland zone comprised of Sycamore (*Platanus occidentalis*) and Sweetgum (*Liquidamber styraciflua*). The tidally influenced portion of the wetland area is located within the western and central portion of IH-01 and consists of a sparsely vegetated mudflat with a centrally located unnamed tributary from Mattawoman Creek to Turkey Run. A low lying upland forested peninsula borders the tidal wetland area to the Northeast and is composed mostly of Sweetgum, Poison ivy, Red maple (*Acer rubrum*), Sweetgum and Silver maple (*Acer saccharum*), with scattered stands of raspberry and Japanese honeysuckle (*Lonicera japonica*). The western edge of IH-01 is bordered by a forested upland populated by a hardwood forest containing the following species: Chestnut oak (*Quercus prinus*), American holly (*Ilex opaca*), and American beech (*Fagus grandifolia*).

Hydrologic indicators observed in freshwater portion of IH-01 included soils saturated at the surface, standing water at surface of test pit, hummocks, and defined drainage patterns. Four soil pits were taken along the eastern boundary of IH-01 to define the wetland line (Figure C-1). Data sheets for the four soils pits (DP-01 through DP-04) are included at the back of this report. No wildlife was observed in the area at the time of delineation.

The soil comprising the majority of IH-01 is classified as Cut and Fill Land (Cu). This land consists, in part, of land areas where the soil has been cut away by grading and similar operations; soil depths vary (USDA, Charles County, MD). The western edge of the wetland is steep with soils classified as Gravelly Land (GvE), 15 to 20% slope. GvE is also represented along the upper eastern edge of the wetland within the upland boundaries. Also along the eastern edge soils classified as Keyport Silt Loam are evident. These soils are characterized as being moderately well drained and commonly observed at low elevations near major rivers (USDA, Charles County, MD). Under ACOE regulations, the resource area was determined to be a wetland and therefore will be regulated.

3.3 Area Two (IH-02)

This area was observed to contain wetland and hydrologic conditions typical of a PEM freshwater wetland and is located near the center of The Project Site. Flags IH-02-01 through IH-02-11 were placed along the area boundary. IH-02 has a total acreage of 0.10, and is found entirely within the Area A site boundary lines.

Vegetation within this section is comprised of mixed upland and wetland species such as *Carex spp*., *Juncus spp*., Marsh mallow, Cattails, Yellow foxtail (*Setaria glauca*), Switch grass (*Panicum virgatum*), and Broomsedge (*Andropogon virginicus*).

Hydrologic indicators were observed to be surface saturation, hummocks and drainage patterns within the delineated area. One soil pit was taken near the center of IH-02 (Figure C-1). The data sheet for the soils pit (DP-05) is included at the back of this report. No wildlife was observed in the area at the time of delineation.

The soil comprising all of IH-02 is classified as Cu. As in the above IH-01, the land area is characterized by soil that has been cut away by grading and similar operations. Soils within the O horizon consisted of 10YR 5/2 and were comprised of fill from previous excavation activities at The Project Site. Within the 6 to 18 inch depth the soils were cataloged as 10YR 4/3 with the same texture and appearance as fill from the O horizon (Data Sheet, DP-05).

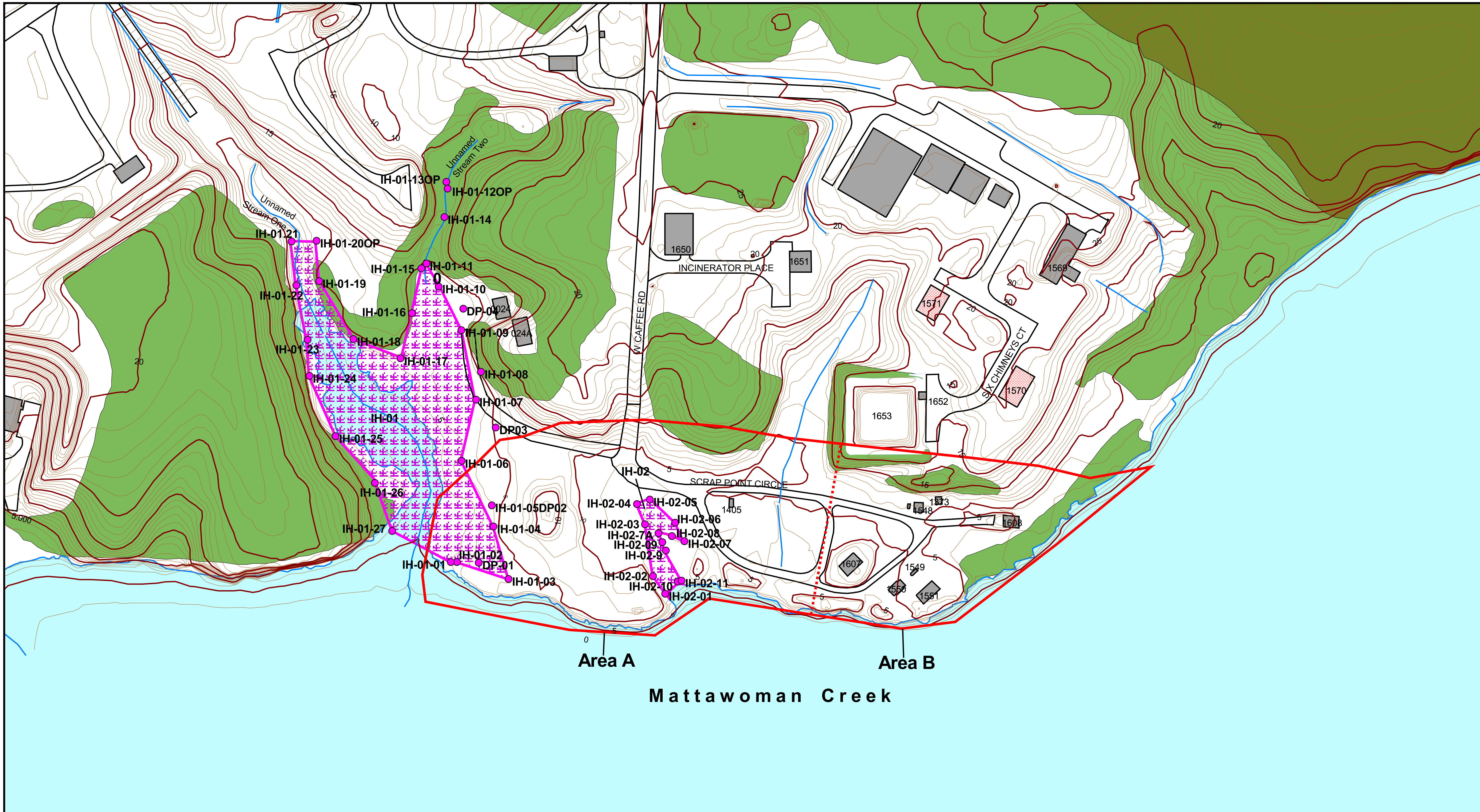
3.4 Conclusion

IH-01 displays vegetation, hydrology and hydric soils which classify this area as a jurisdictional wetland.

IH-02 displays vegetation, hydrology, but no hydric soil. This small freshwater area was the result of construction activities within the Project Site. Due to the abnormal site characteristics the area does not meet the full criteria of a wetland or “Water of the US” according to the US Army Corps of Engineers 1987 Manual, but would be considered an atypical wetland subject to a jurisdictional call by the US Army Corps of Engineers and Maryland Department of the Environmental.

Pursuant to ACOE regulations, restoration and mitigation would be required for temporary and/or permanent impact to regulated wetlands resulting from remedial practices implemented on the Project Site.

File Path: v:\18gis\indianhead\figures\Site11.apr



LEGEND

- Approximate Site Boundary
- Drainage Ditch
- Buildings
- Demolished Buildings
- Railroads
- Roads
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- Site 11 Area Divide
- Wetland Area
- Wooded Area
- Dense Wooded Area

N

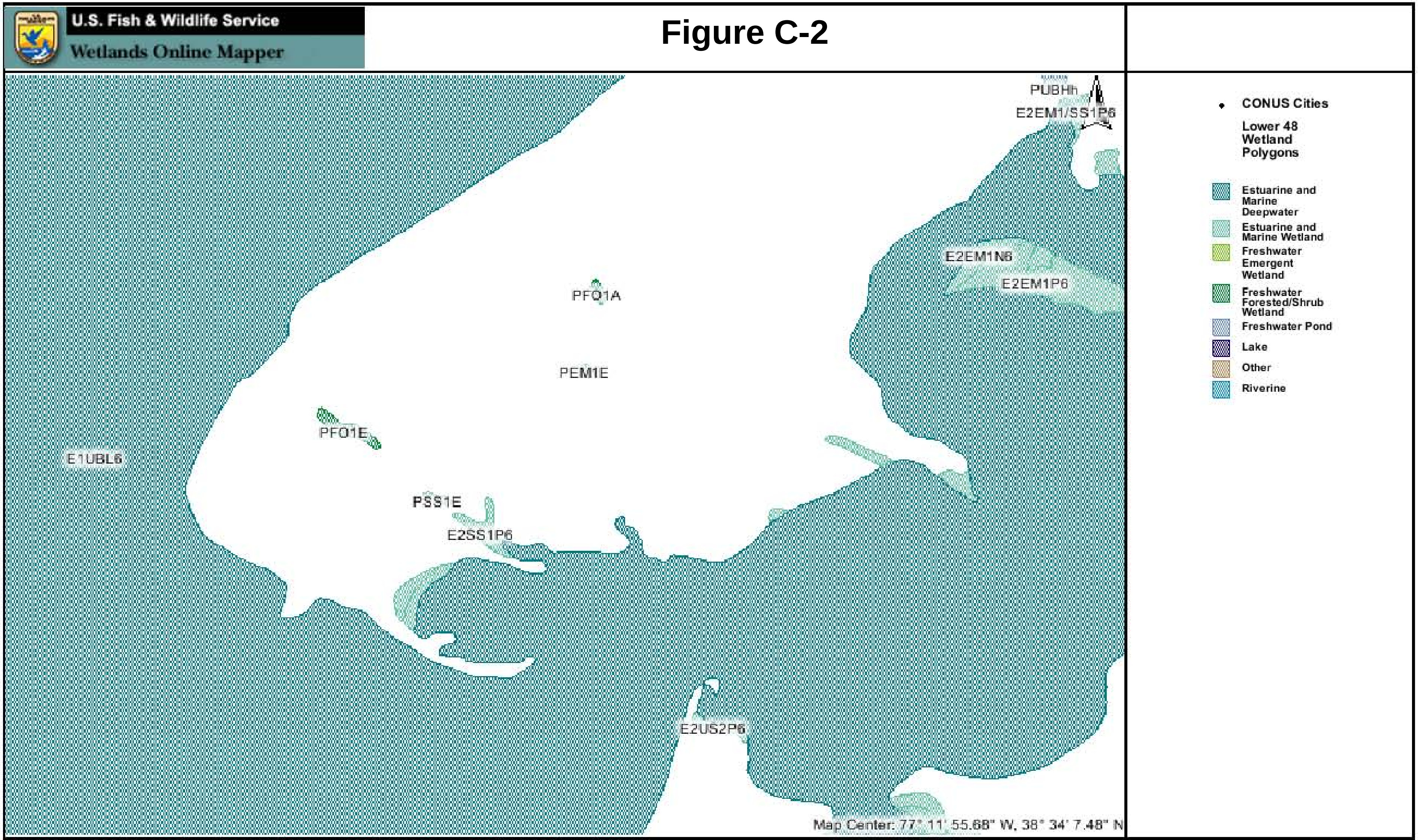
70 0 70 140 210 Feet

Figure C-1
Site 11 - Waterbodies, Streams, and Wetlands
NDWIH, Indian Head, Maryland

CH2M HILL, Inc. performed a Wetland Delineation of Site 11 on Feruary 10, 2005
utilizing a Global Positioning System to record and locate wetland flags, data points and existing features.

CH2MHILL

Figure C-2



This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Indian Head Quad National Wetlands Inventory (NWI) Map

Map Scale Unavailable (unprojected data)

Appendix D
Geophysical Survey Results and Interpretation

Appendix D.1
Results and Interpretation of the May 2006 Geophysical Survey at Site 11, NSF-IH, Indian Head, Maryland

Results and Interpretation of the May 2006 Geophysical Survey at Site 11, NSF-IH, Indian Head, Maryland

TO: Gunarti Coghlan/WDC
Margaret Kasim/WDC

COPIES: Randy Underwood/WDC

FROM: Tamir Klaff/WDC

DATE: June 29, 2007

PROJECT NUMBER: 185522.PP.MG

The following subsections summarize the digital geophysical mapping (DGM) surveys performed at the site and interpretation of the results. A detailed report describing the surveys and survey results is provided in Appendix D.2.

DGM Survey Results

The DGM surveys were performed in the northern and eastern areas of the site, as shown on Figure D.1-1, with the intent of detecting and mapping material changes across the site that could provide useful information with respect to the extent of solid waste. Survey activities were performed on May 8, 9, 10, and 18, 2006 using the following three technologies:

1. Total field magnetics (Geometrics G-858 magnetometer)
2. Ground terrain conductivity (Geonics EM31)
3. Ground-penetrating radar (GPR) (GSSI SIR-3000)

Results of the magnetometer and terrain conductivity surveys are shown as Figures D.1-2 and D.1-3, respectively. An example of one of the GPR transect results is presented as Figure D.1-4, and the remainder of the GPR surveys are included in Appendix D.2.

DGM Survey Interpretation

An analysis of the DGM surveys by the CH2M HILL Project Geophysicist indicates that the results between each survey are complementary to each other and are in agreement with soil boring results; representative samples are shown on Figure D.1-5. All of the survey results indicate two areas of high-density anomalies, shown on Figures D.1-2 and D.1-3. Additional metallic anomalies were detected outside of these areas; however, these anomalies can primarily be explained by the presence of surface metallic items and cultural features (labeled on the figures.) While it is not possible without intrusive investigation to conclusively demonstrate that an anomaly having a surface feature associated with it does not have a subsurface source as well, it is reasonably clear from the three DGM surveys, interpreted together, that the only areas with significant subsurface anomalies (that might be interpreted as solid waste material) are the two areas shown in Figures D.1-2 and D.1-3.

A site visit by the CH2M HILL Project Geophysicist with a handheld mobile geographic information system loaded with the DGM results and integrated with a global positioning system revealed that the northern edge of the high-density anomaly areas coincides with the tops of the slopes of the two hills on the north side of the site. This suggests that the solid waste materials were either pushed up against the sides of the hills or pushed from the tops of the hills down onto the slopes.

Based on the DGM results, coupled with soil boring data and field observations, the initial solid waste extent, shown on Figure D.1-6, has been revised such that the northern extent is at the tops of the hill slopes and the eastern extent is along the interior edge of the DGM surveys performed on the eastern side.

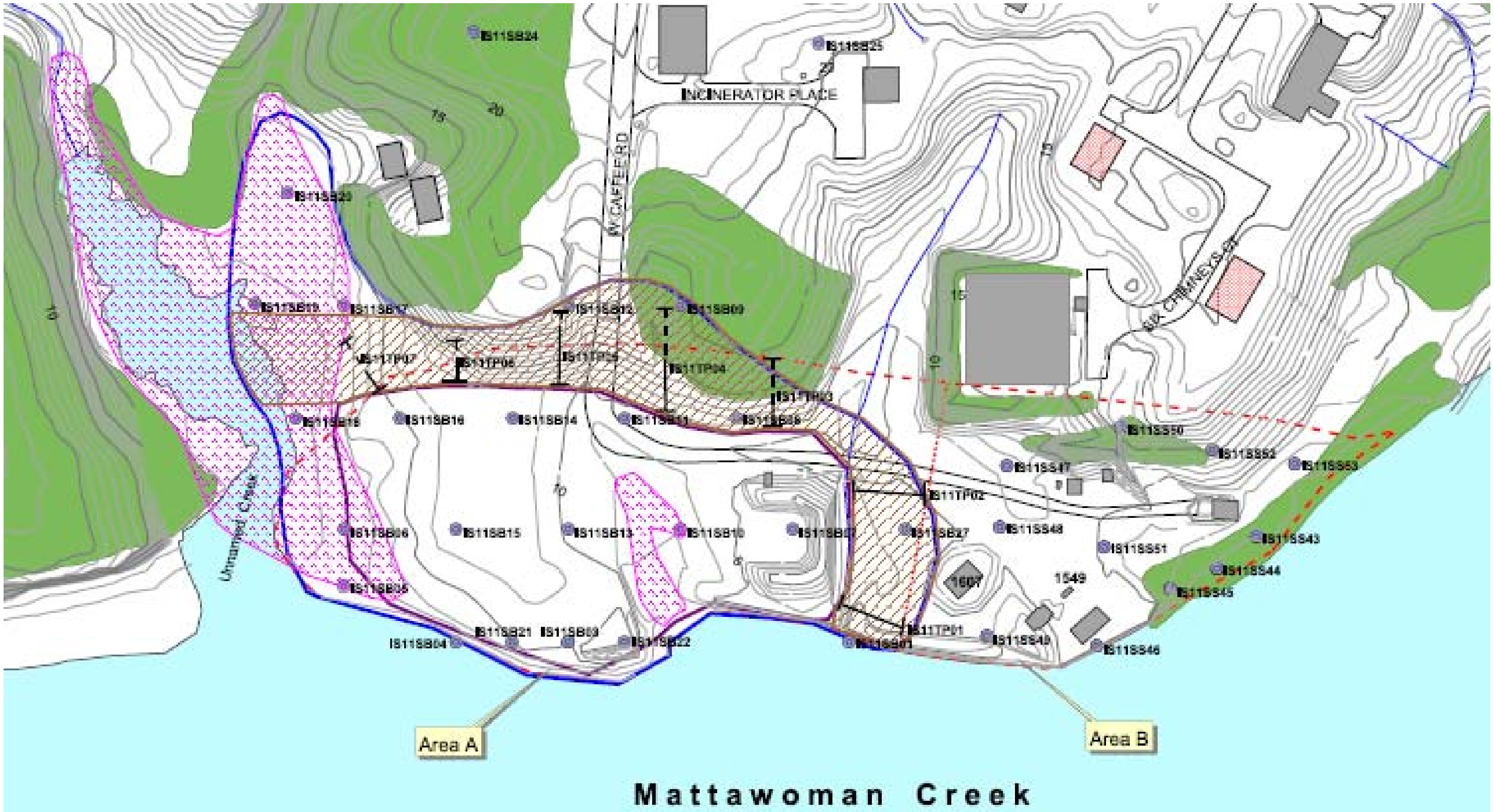


FIGURE D.1-1
GEOPHYSICALSURVEY AREA
Site 11 Geophysical Survey
NSF-IH, Indian Head Maryland

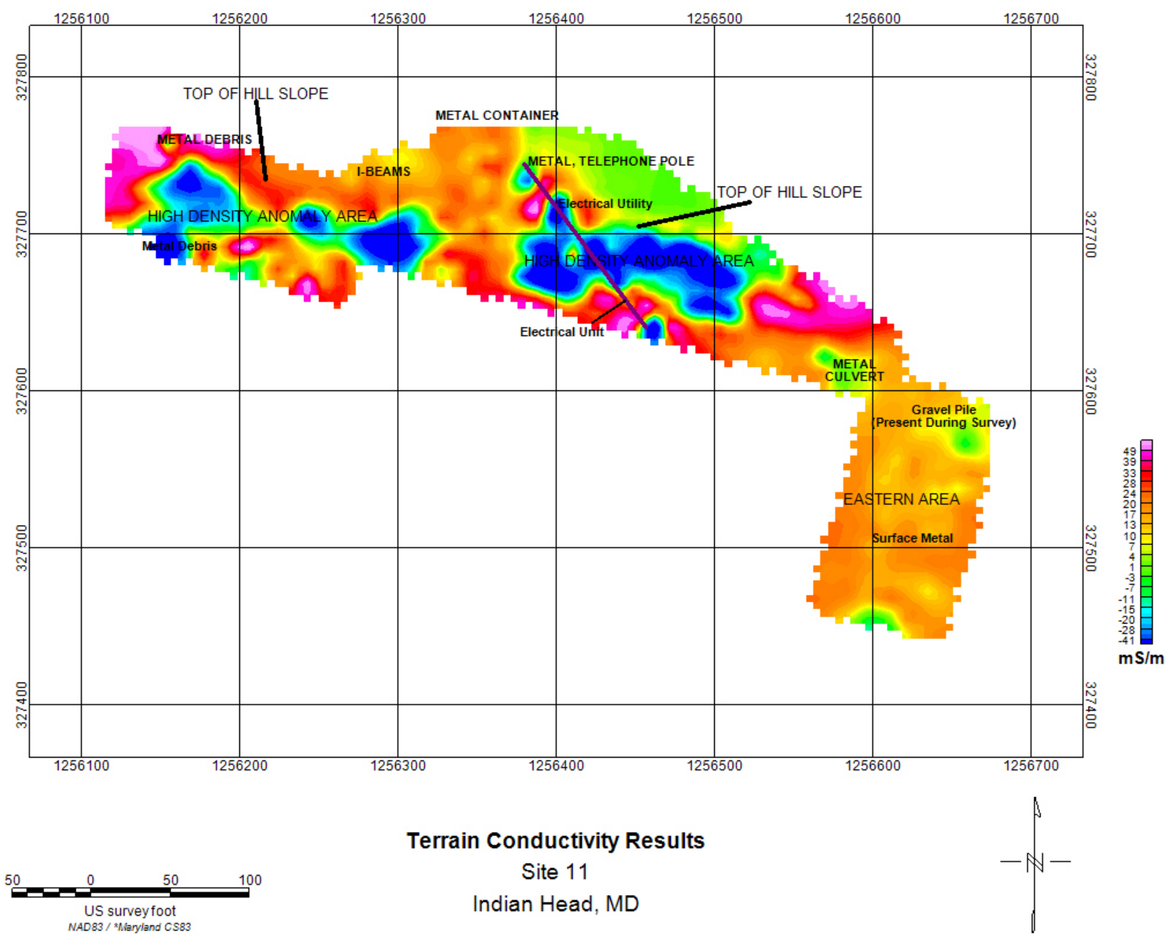


FIGURE D.1-2

TERRAIN CONDUCTIVITY RESULTS

Site 11Geophysical Survey

NSF-IH, Indian Head Maryland

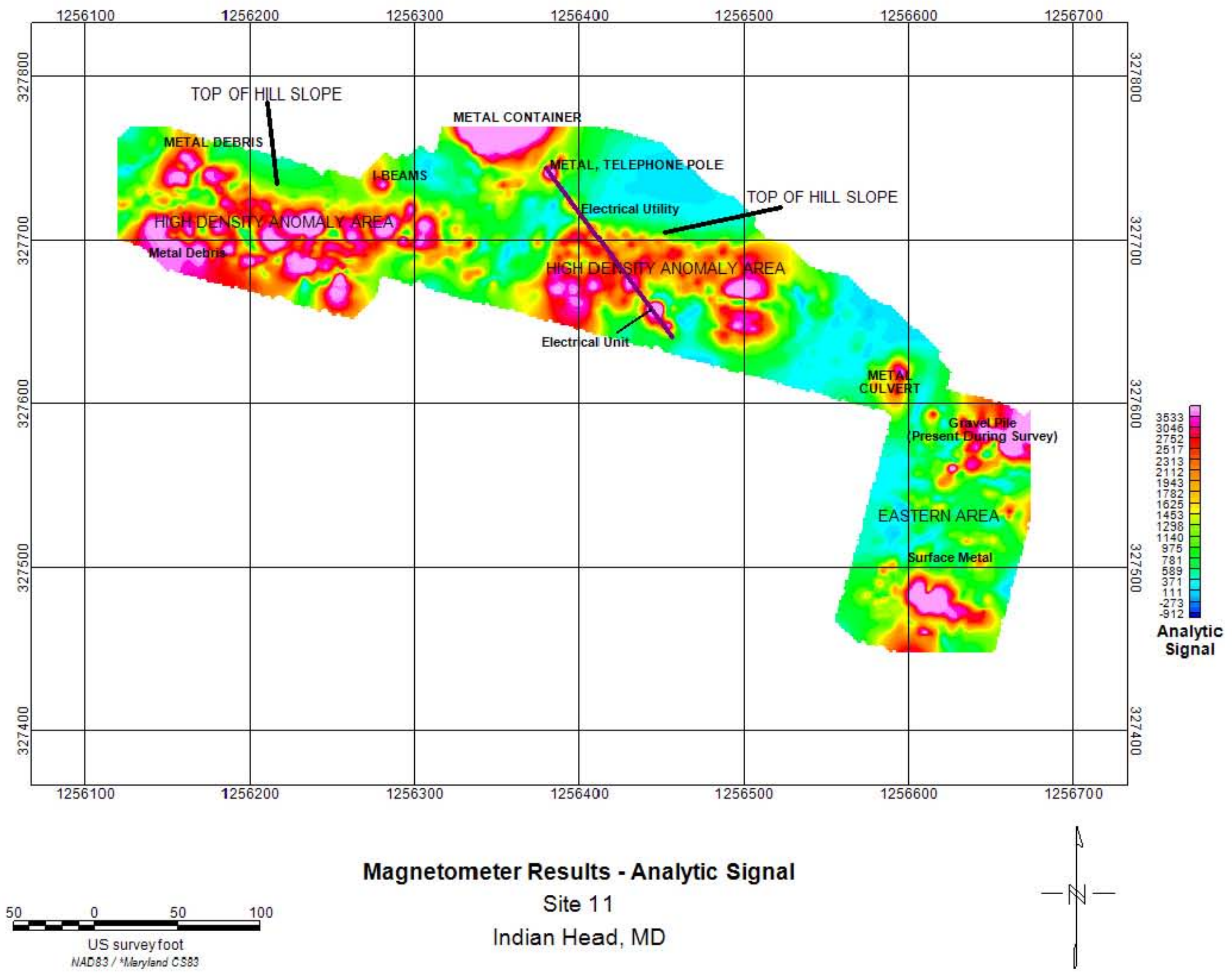


FIGURE D.1-3
MAGNETOMETER RESULTS – ANALYTIC SIGNAL
Site 11Geophysical Survey
NSF-IH, Indian Head Maryland

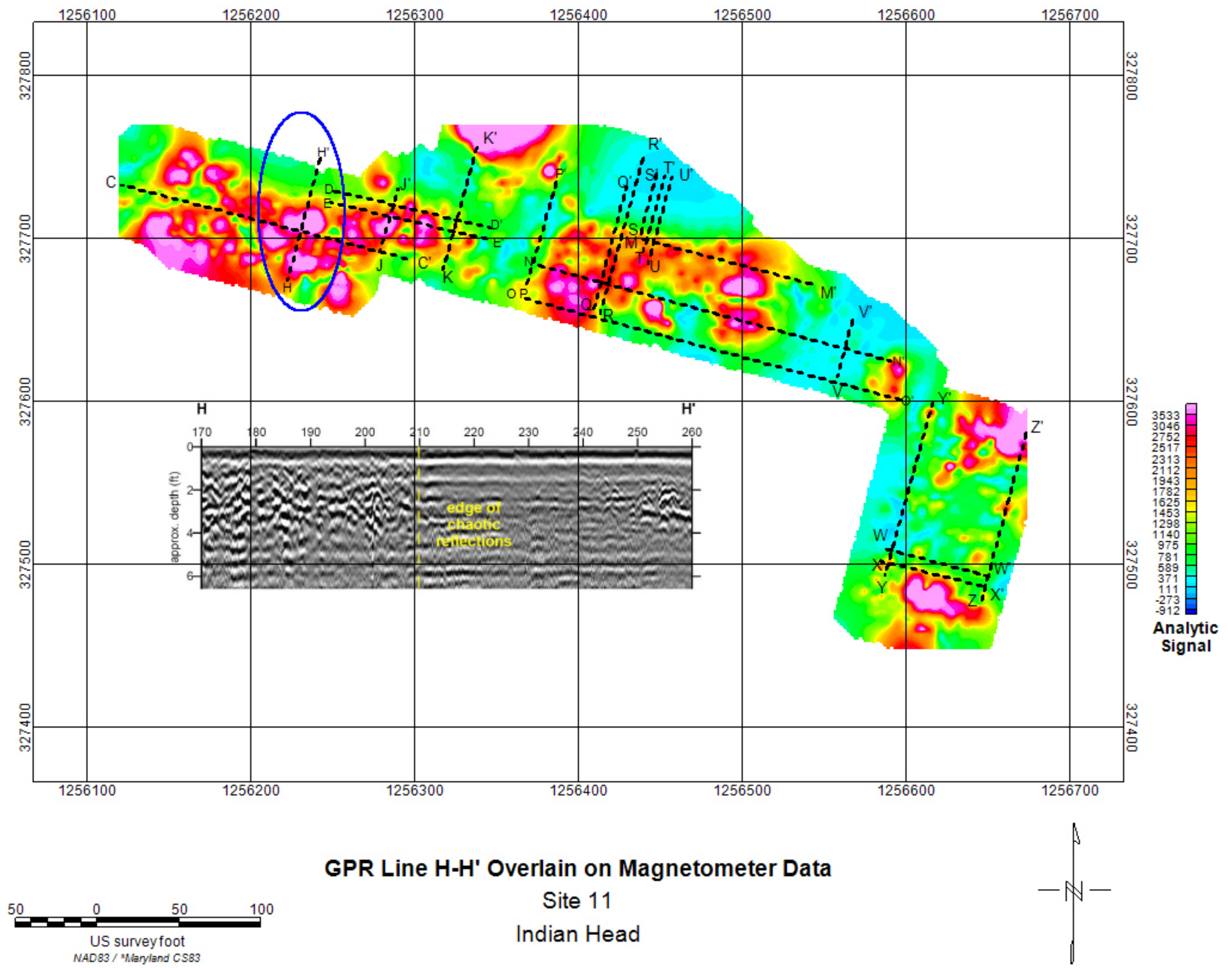


FIGURE D.1-4
MAGNETOMETER RESULTS – GPR OVERLAIN
Site 11Geophysical Survey
NSF-IH, Indian Head Maryland

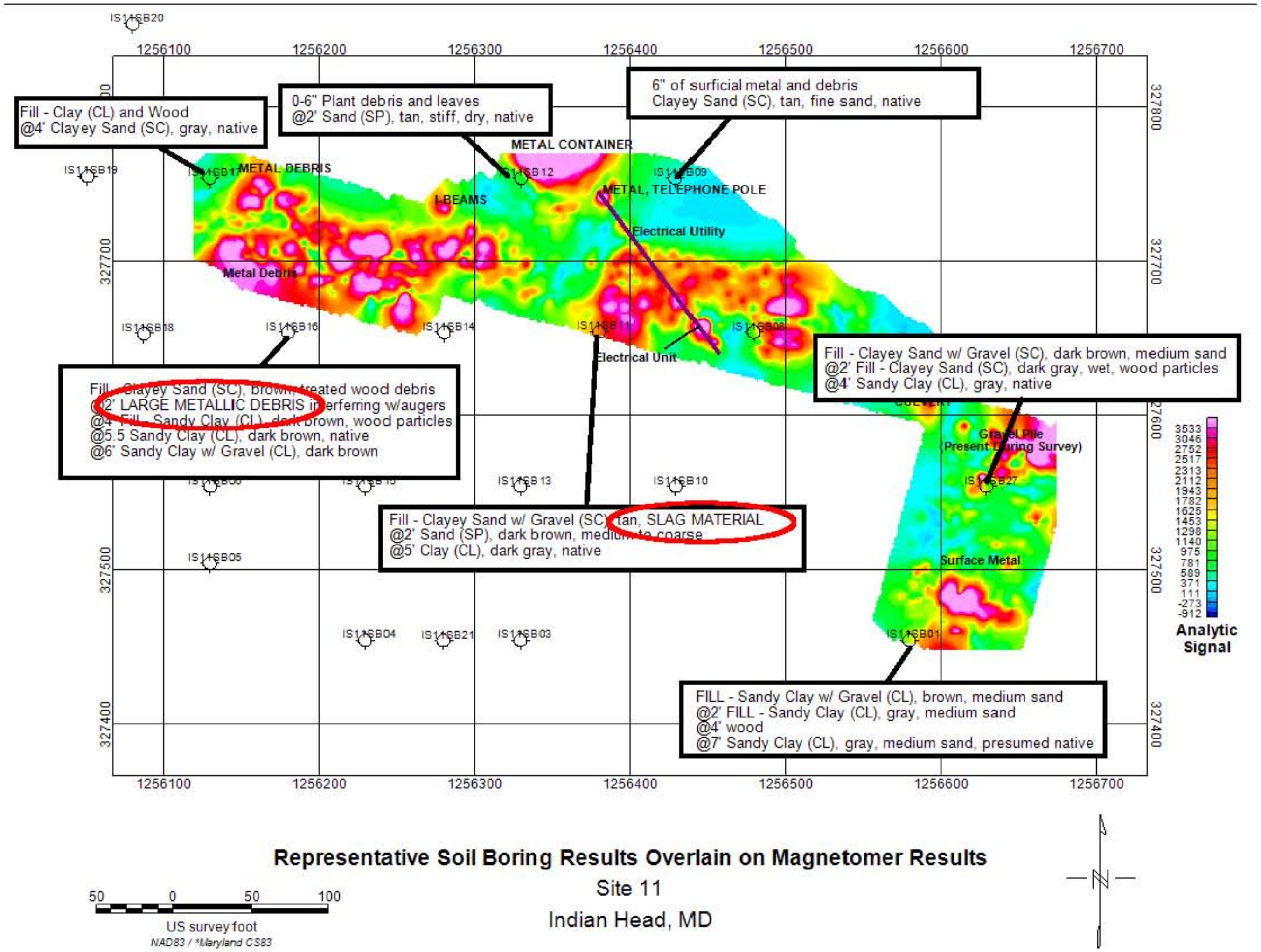


FIGURE D.1-5
OVERLAIN SOIL BORING AND MAGNETOMETER RESULTS
Site 11Geophysical Survey
NSF-IH, Indian Head Maryland

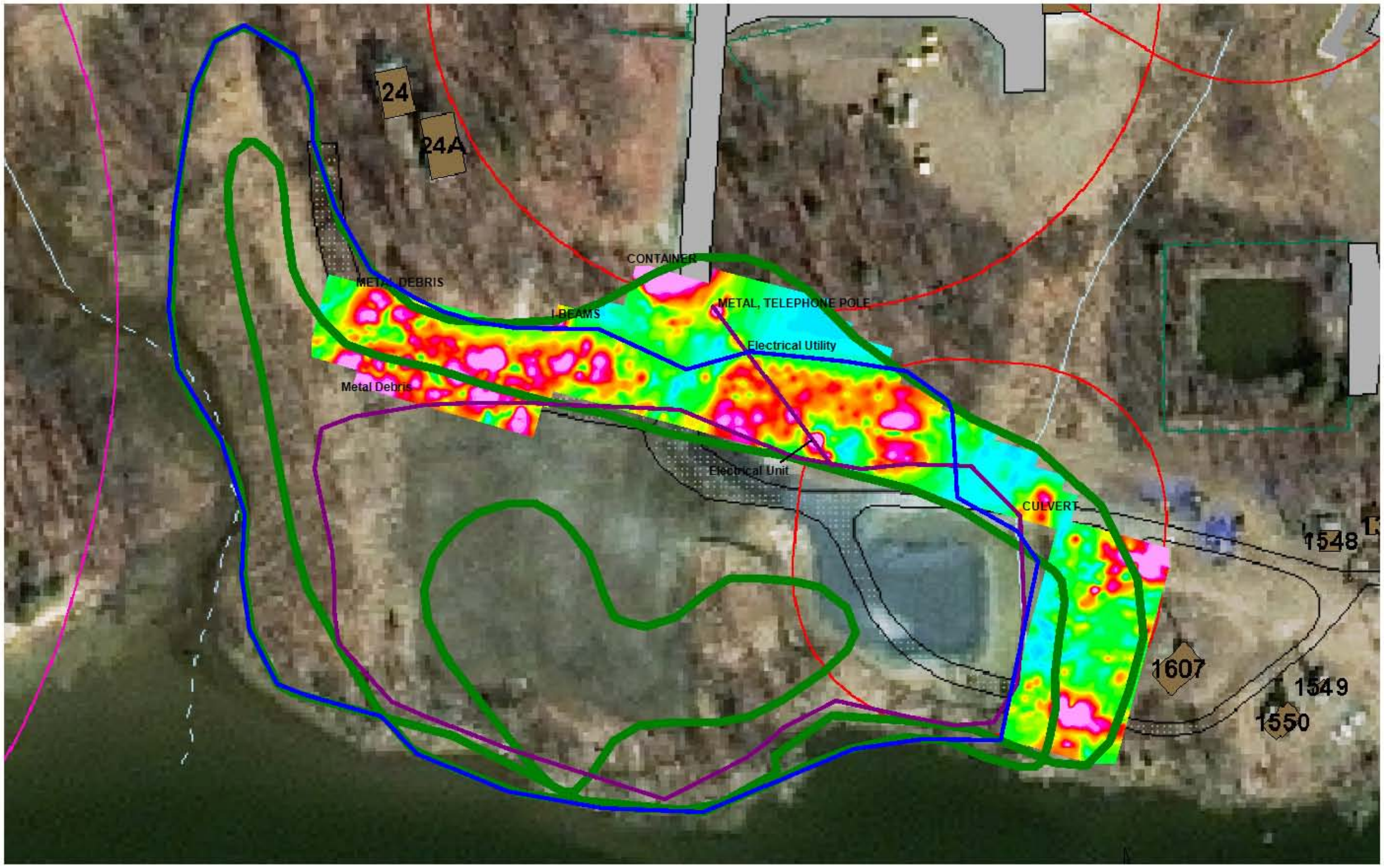


FIGURE D.1-6
INTERPRETATION OF EXTENT OF SOLID WASTE AREA
Site 11Geophysical Survey
NSF-IH, Indian Head Maryland

Appendix D.2
Geophysical Survey Results – ERT Report

Earth Resources Technology, Inc.

June 13, 2006

Gunarti Coughlan
CH2M Hill
13921 Park Center Road
Suite 600
Herndon, VA 20171

RE: Results of Geophysical Surveys, Site 11, Caffee Road Landfill, Indian Head Navy Base, Indian Head, Maryland

Dear Ms. Coughlan:

This report discusses geophysical investigations carried out by Earth Resources Technology, Inc., at Caffee Road Landfill, Indian Head Navy Base, Indian Head, Maryland, for CH2M Hill, on May 8, 9, 10, and 18, 2006.

I. Purpose and Scope of Investigation

The purpose of the geophysical investigations was to characterize the subsurface in an area approximately 500 feet long by 250 feet wide on the banks of the Mattawoman River. Data gathered from the subsurface investigation will be used to guide Geoprobe operations to follow.

The geophysical instruments used to characterize the site were a Geometrics G-858 Magnetometer, a Geonics EM31, and a GSSI SIR-3000 Ground Penetrating Radar (GPR). The magnetometer detects ferrous metals. The EM31 detects changes in ground conductivity as well as the presence of ferrous and non-ferrous metals, although it is not as sensitive as the magnetometer. Results from these two instruments are displayed as contour maps of the site. The GPR collects images of the subsurface in the form of profiles that can be interpreted individually.

II. Field Methods and Equipment

<u>Survey Grid</u>

A 240’ x 520’ grid was laid out in the field on the first day of the survey, with an arbitrary baseline (Y=200’) trending approximately east-west along the length of the site. The X-axis increases to the east, and the Y-axis increases to the north. Grid marks were placed every 10 feet on the ground, and orange pin flags with grid coordinates were placed at many locations in order to facilitate mapping and surveying. The grid was subsequently expanded to the west 50 feet on the last day of the survey. When the grid was expanded, a large amount of metallic debris was moved from the surface into two piles at the edges of the grid (labeled “metal debris” on Plots 1 and 2). The grid can be divided into three general areas for reference: The *western area* includes the parts of the grid to the west of the road, or from X=50’ to X=280’; the *central area* includes the parts of the grid from the road to X=550’; the *eastern area* includes the parts of the grid from X=550’ to the east and south of the baseline.

Utility Locating

The RadioDetection model RD433HCTx-2 unit was used to locate utilities at the site. The device can locate electrical lines passively and can locate other utilities by direct connection. An electric line (obvious as a partially exposed pair of PVC pipes connecting a telephone pole to an electrical building) was located and marked with pin flags with the letter "E" on them. A water line was located and marked with pin flags with the letter "W" on them.

Magnetic Survey

A Geometrics Portable Cesium Magnetometer, Model G-858, was used for the magnetic survey. Using self-oscillating split-beam Cesium vapor (non-radioactive Cs-133), this magnetometer measures the earth's total geomagnetic field (magnetic flux density) at a particular location in units of nanoteslas (nT) with an accuracy of ±1.0 nT. It collects a maximum of 10 magnetic readings per second. The total field consists of three components: the main field of the earth, the external field caused by the sun and moon, and local variations caused by objects at the site. The main field and external field remain relatively constant over the period of time of a field investigation. Local variations are attributable to anomalies near the surface such as buried ferrous metal objects or above-ground objects containing ferrous metal. Magnetic data were collected along and between grid lines in the field with 5' separation between transects.

The magnetic survey was conducted on two separate days. On May 9, data were acquired over the entire grid from X=100' to the east. On May 18, the grid was expanded to the west and magnetic data were acquired over the expanded western area. The data acquired in the western area on May 9 are not shown in this report, because it is very similar to that acquired on May 18.

Electromagnetic Survey

The Geonics EM31 was used for the electromagnetic survey. The EM31 measures the changes in the ground conductivity using a patented electromagnetic inductive technique that makes the measurements without electrodes or ground contact. The EM31 has two analog meters that display the quadrature-phase (conductivity) and in-phase components of the electromagnetic field. The unit of conductivity used is millisiemens per meter (mS/m). Conductivity changes are used to infer geological variations, or groundwater contamination. In-phase measurements are the ratio of the induced secondary magnetic field to the primary magnetic field in parts per thousand (ppt). The in-phase component is especially useful for searching for buried metal drums, pipes, and other ferrous and non-ferrous metallic debris. The effective depth of exploration of the equipment is about 20 feet.

Electromagnetic data were collected along grid lines with 10' separation between readings, forming a uniform grid. The spatial resolution of this data is much less than that of the magnetometer.

Different orientations of the transmitter and receiver on the EM31 can produce different readings at the same points. For this reason, the survey area was covered with the instrument at two orthogonal orientations, with the receiver pointing north and pointing east. On May 9, the data were acquired over the entire grid from X=100' to the east, with the receiver pointing east. On May 18, the data were reacquired in the expanded western area with the receiver pointing north and pointing east, and in the central area with the receiver pointing north. There was no time to reacquire the data in the eastern area with the receiver pointing north because the grid had been destroyed or covered by heavy equipment activities.

Ground Penetrating Radar Survey

The SIR-3000 Ground Penetrating Radar unit, manufactured by Geophysical Survey Systems, Inc. (GSSI), was used to conduct the GPR survey. The device radiates a polarized electromagnetic wave from a transmitter antenna into the earth and receives at a receiving antenna the reflection of the wave from subsurface interfaces at which changes in the electrical properties (dielectric permittivity and electrical conductivity) of the subsurface materials occur. Dielectric permittivity controls wave speed; and conductivity determines the signal attenuation. Radar reflections occur when the radio waves encounter a change in the velocity or attenuation. The greater the change in properties the more signal is reflected. These properties may be controlled by water in the material, hence by the porosity and quantity of dissolved solids in the water. Also, metallic objects usually exhibit strong subsurface reflection character due to their high electrical impedance or contrast versus surrounding soil or fill. Depth of penetration of the radar signal is inversely proportional to the conductivity of the soil. As a result, electrically resistive earth materials such as coarse-grained, unsaturated sediments allow a deeper radar penetration than the conductive finer-grained soils such as clay and silt. Similarly, reinforced concrete and shallow groundwater are conductive and thus attenuate the radar signals. The 400 MHz antenna was used for this survey. The odometer was set up such that 10 radar readings would be acquired every foot. The average velocity of the radar is estimated around 0.1 m (0.328 ft) per nanosecond (ns). The time range selected was 80 ns and such a time range would allow a theoretical penetration depth of about 13 feet. The GPR data were recorded digitally in a portable computer for instant display and subsequent processing.

The collection of the GPR data was performed by pulling the antenna along grid lines in both the X and Y directions over areas where terrain and vegetation permitted it. Due to an unexpected equipment malfunction, the data acquired on May 10 over most of the site and the data acquired on May 18 in the expanded part of the western area have slightly different acquisition parameters (gains and filters). This accounts for the different appearance on Plot 3 of profiles collected between X=50’ and X=100’ on May 18 from those collected elsewhere on May 10.

III. Data Reduction and Processing

Magnetic Data Processing

Data from the G-858 were downloaded to a laptop using MagMap2000 software where they were spatially corrected (to fit site features) and exported to Surfer format. Dropouts, or zero readings, are caused by magnetic field lines passing through the sensor at angles outside of its cone of sensitivity, and these were removed using MagMap2000. Griding of the data was accomplished using the method of kriging.

Electromagnetic Data Processing

The data were downloaded from the EM31 Datalogger to a PC where they were placed directly into a Surfer data sheet. The data were gridded using the method of kriging.

Ground Penetrating Radar Data Processing

The data were collected onto a flash card in the SIR-3000 unit and downloaded to a PC. The data were time-zero corrected and gains were applied to all files using Radan software distributed by GSSI. All files were converted to bitmaps using Rad2bmp, also distributed by GSSI. The bitmaps were converted to GIF files using Adobe Photoshop in order to save memory. The GIF files were imported into Surfer for final display.

The vertical axis of GPR profiles is in time, rather than depth. Because a radar wave must travel from the transmitter through the subsurface medium to the target and back through the medium to the receiver, it is said to have a “two-way travel time.” The units are nanoseconds (ns). The data were collected such that the records are 80 ns long, which was subsequently cropped to 40 ns after the "time-zero" correction was applied. However, nannoseconds are often not a useful unit for presentation of the data, so a conversion is made to depth by using an assumed velocity of 0.1 m/ns, which is an average for earth materials. All vertical axes have been converted from time to depth in feet, but one must remember that these depths are not precise, and may be over- or underestimates, particularly at depth.

IV. Results and Interpretation

Results from the magnetic survey are displayed in Plot 1, which includes the magnetic contour map, a post map showing the locations of data points, and GOES satellite data supporting the validity of the data. The magnetic contour map is displayed at a 500 nT contour interval. Readings above background (approximately 52,000 nT) are shown as shades of red, while readings below background are shown as shades of blue. It shows many anomalies. The varying intensity of the magnetic field in all three areas (western, central, and eastern) is most likely caused by buried metallic debris, and indicates that it is buried beneath most of the site. A dashed green line indicates the approximate extent of this "landfill material." The magnetic anomalies north of the dashed green line in the western and central areas are all most likely caused by surface objects such as the containter, telephone poles, guy wires, fire hydrants, etc. One anomaly in particular, located about 15 feet to the east of the culvert, is a magnetic dipole, and GPR data, discussed below, gives some indication of the object's properties. Scattered anomalies occur throughout the eastern area. The most intense anomaly in the eastern area is a dipole (high next to low) centered at coordinates [585,85].

Results from the EM31 survey are displayed in Plot 2, which includes contour maps of both quadrature and inphase readings with the receiver pointed both north and east. The quadrature (conductivity) contour maps are displayed at a 10 mS/m contour interval. The inphase contour maps are displayed at a 5 ppt contour interval. There are differences between the data acquired with the receiver pointed north versus that acquired with the receiver pointed east, but the general pattern of both quadrature and inphase anomalies is essentially the same as that observed on the magnetic contour map in Plot 1. The electrical utility shows up particularly well on the inphase maps.

Representative GPR profiles and a map showing their locations are shown in Plot 3. Profiles **A-A'** through **K-K'** are from the western area, profiles **L-L'** through **V-V'** are from the central area, and profiles **W-W'** through **Z-Z'** are from the eastern area. Stations on parallel profiles are aligned with each other for ease of comparison.

In the western area, all profiles show some degree of "saturation" with chaotic reflectors. Profile **D-D'** shows a good example of isolated chaotic reflectors. Profiles **H-H'** and **I-I'** (as well as adjacent, parallel profiles not displayed) show a fairly clear edge to the chaotic reflections that correlates approximately with the edge of the landfill material identified from the magnetic data and shown in Plot 1. Other scattered strong or chaotic reflectors are present on other profiles.

In the central area, a similar pattern of chaotic reflectors correlating with the landfill material identified from the magnetic data is evident. Exceptions occur at the north ends of profiles **R-R'** through **U-U'**, where chaotic reflections occur that do not correspond to any magnetic or EM anomalies on Plots 1 or 2. An important anomaly occurs at the eastern end of profile **O-O'**, about 15 feet to the east of the culvert pipe visible on the profile. This is a strong, clear, hyperbolic reflector at about 2 feet below the ground surface. It correlates with a magnetic dipole, and may represent a buried pipe, drum, or some other cylindrical metallic object.

In the eastern area, most profiles acquired looked similar to profiles **W-W'** through **Y-Y'**, with scattered chaotic reflections. Profile **Z-Z'**, along the eastern margin of the surveyed area, shows what may be the bottom of a fill surface (an area that was excavated to the level of the reflector and then backfilled). Profiles **W-W'** and **Y-Y'** were acquired across the strongest magnetic anomaly, but show nothing that was not observed on other profiles in the eastern area.

V. Summary and Conclusion

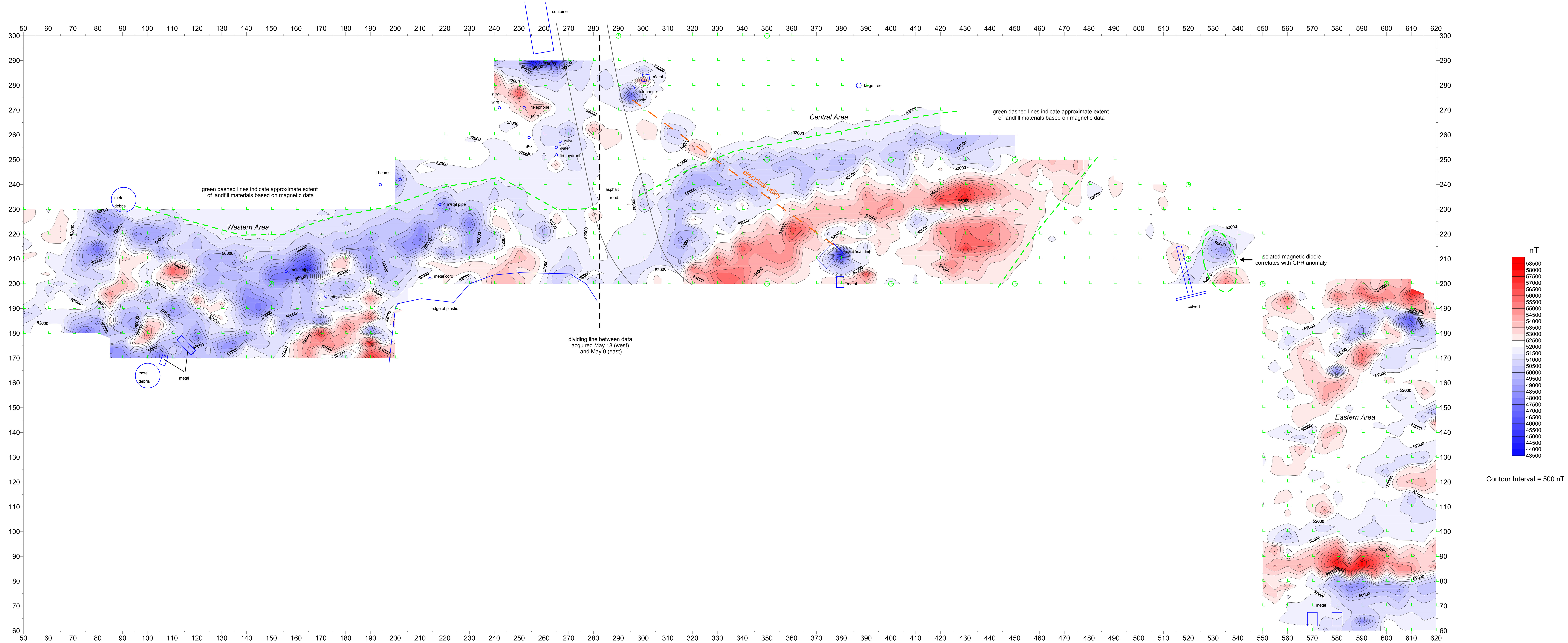
The magnetic and electromagnetic data correlate well with each other and seem to be the best way to delineate the extent of landfill material at this site. The extent of the landfill is delineated on Plot 1, and this interpretation is supported by EM and GPR data. A cylindrical metallic object is buried about 15 feet to the east of the culvert pipe.

The field procedures and interpretative methodologies used in this project are consistent with standard, recognized practices in similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past result of similar surveys although it is possible that some variation could exist at this site. This warranty is in lieu of all other warranties either implied or expressed. **ERT** assumes no responsibility for interpretations made by others based on work performed by or recommendations made by **ERT.**

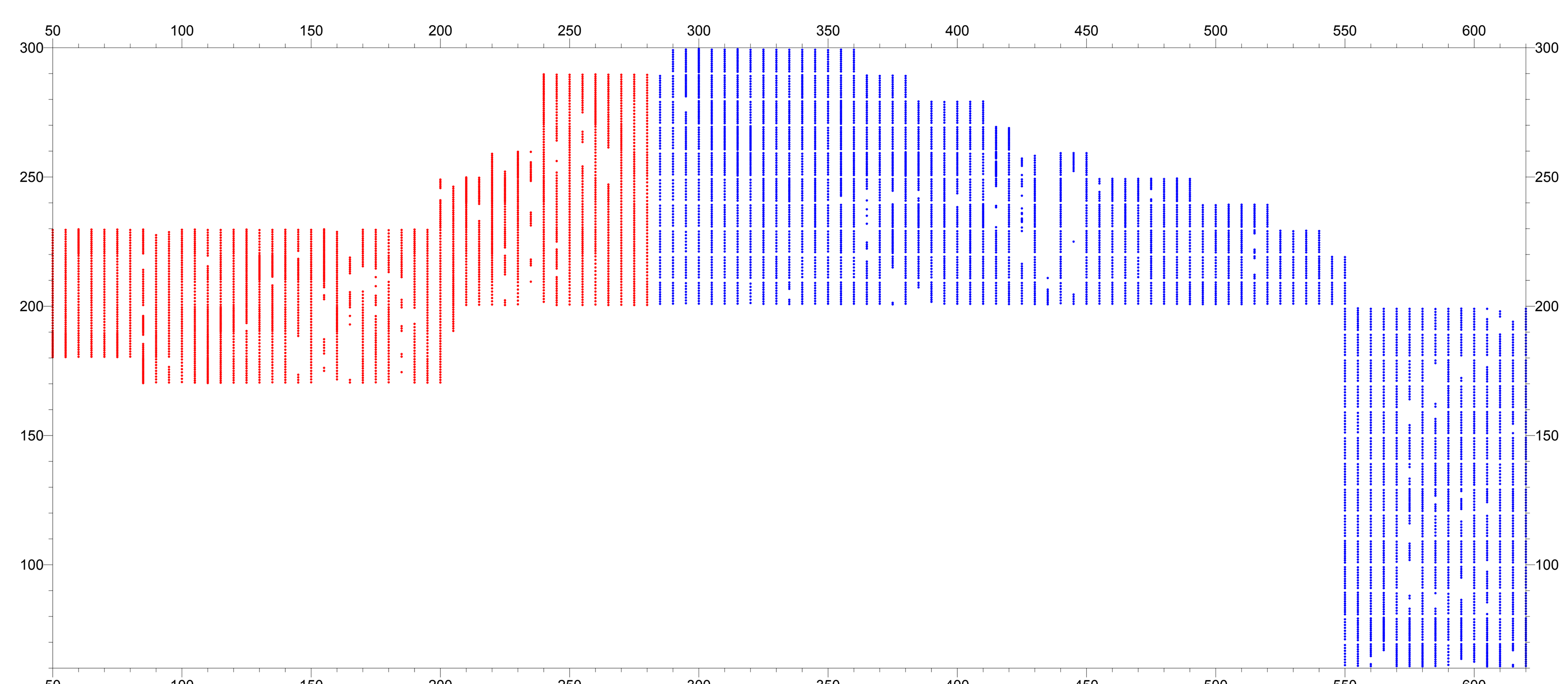
Sincerely,
Earth Resources Technology, Inc.

James L. Stuby, M.S., P.G.
Project Geophysicist

Enclosures: Plots 1-3

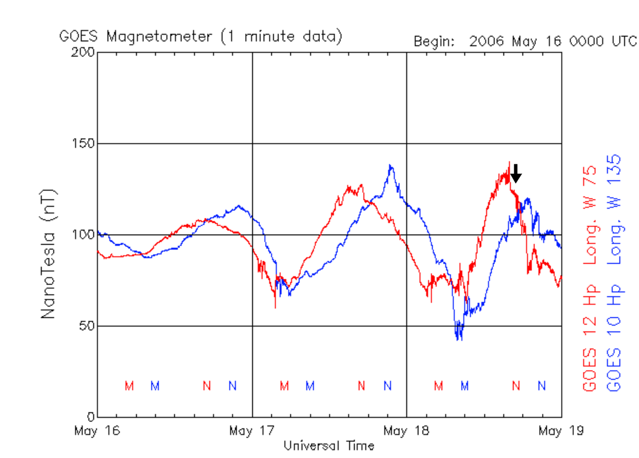


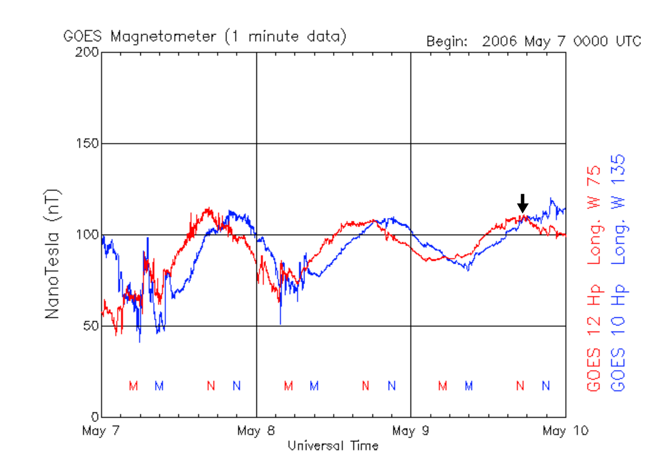
All distances in feet.



This map shows the locations of data points collected with the Geometrics G-858 Magnetometer on May 9 (blue dots) and May 18 (red dots). Gaps in the data set are "drop-outs" caused by the magnetic field vector passing outside the instrument's cone of sensitivity. This phenomenon is generally caused by the presence of strong local magnetic fields such as the metallic debris visible on the surface at this site.

Scale: 1" = 50'

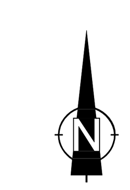




The black arrows on these graphs show the approximate times of the magnetic surveys at this site. The red lines show the magnetic field variation with time as measured by the GOES-12 Satellite, which is in geostationary orbit over the east cost of the United States. The variation over the duration over the surveys is negligible.

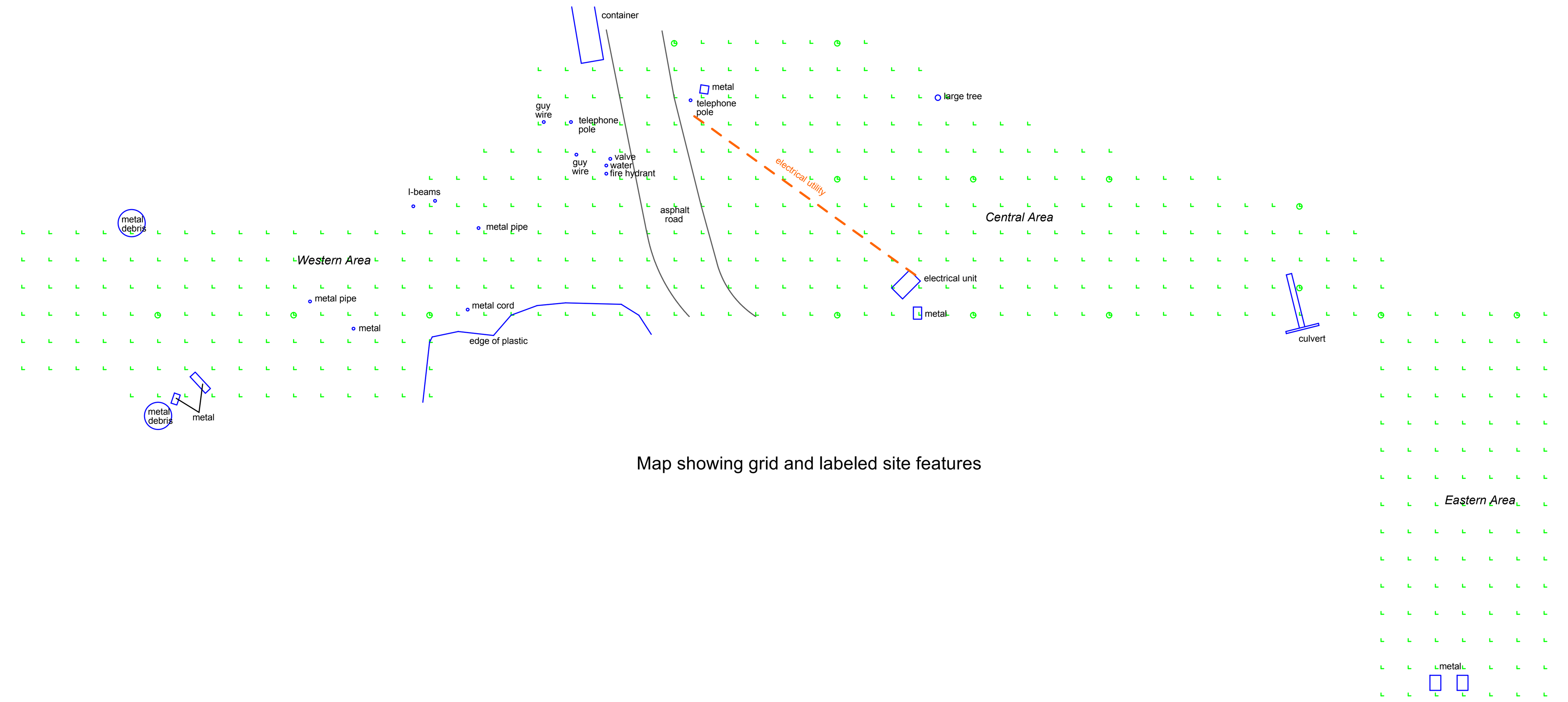
These graphs and the following text were downloaded from the following NOAA website:
http://www.sel.noaa.gov/rt_plots/mag_3d.html

"The GOES Hp plot contains the 1-minute averaged parallel component of the magnetic field in nanoTeslas (nT), as measured at GOES-12 (W75) and GOES-10 (W135). The Hp component is perpendicular to the satellite orbit plane and Hp is essentially parallel to Earth's rotation axis. If these data drop to near zero, or less, when the satellite is on the dayside it may be due to a compression of Earth's magnetopause to within geosynchronous orbit, exposing satellites to negative and/or highly variable magnetic fields. On the nightside, a near zero, or less, value of the field indicates strong currents that are often associated with substorms and an intensification of currents in the Earth's geomagnetic tail."

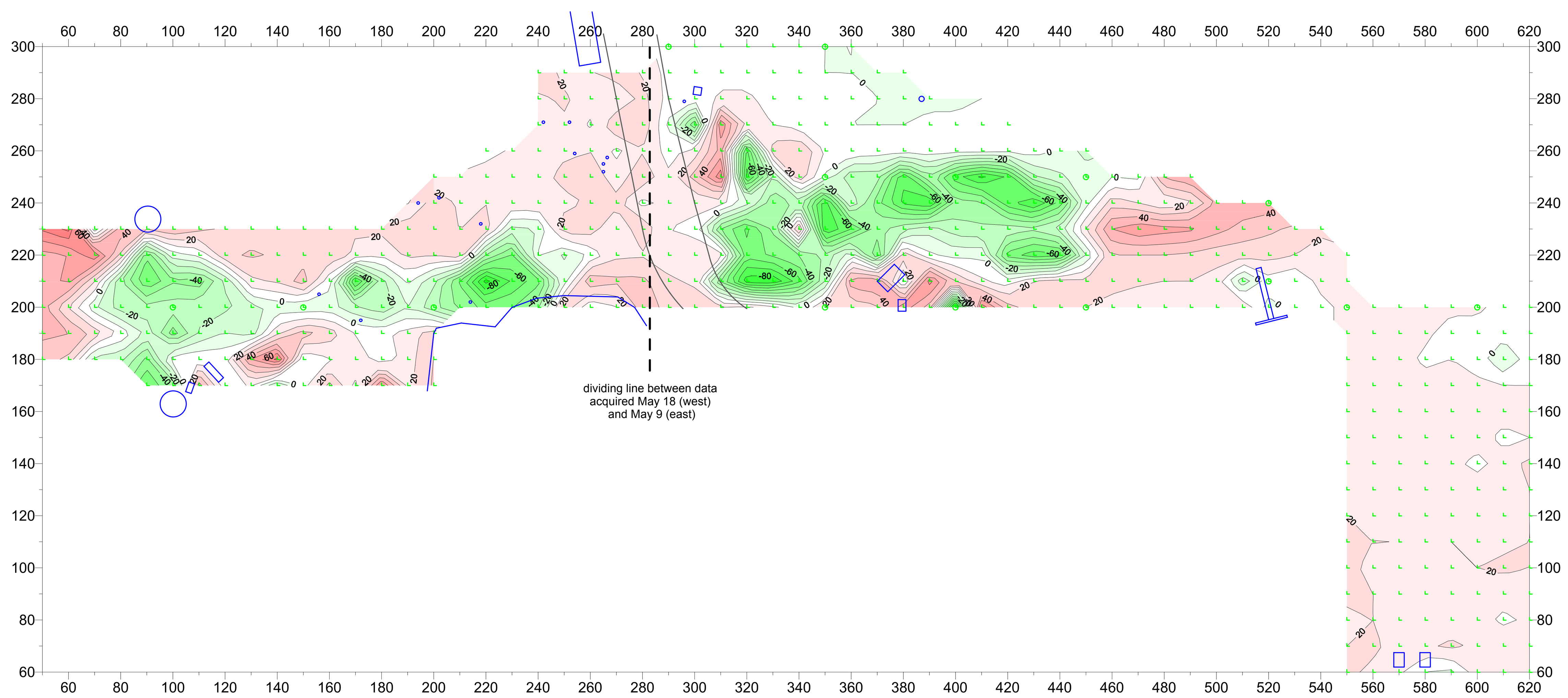


approximate

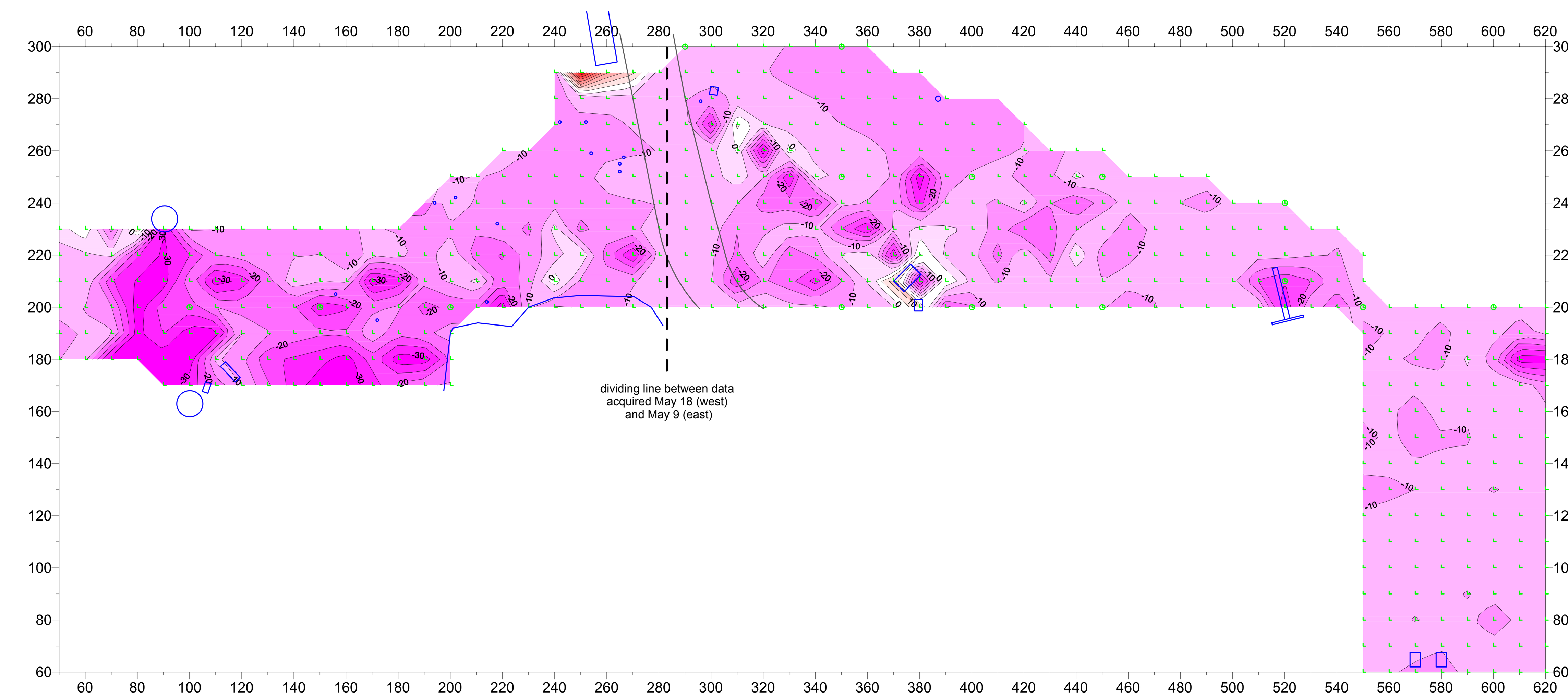
Earth Resources Technology	**Magnetic Flux Density Contour Map** **Site 11 - Caffee Road Landfill** **Indian Head Navy Base, Maryland** **Prepared for CH2M Hill.**	**PLOT 1**	
		June 13, 2006	
		Scale: 1" = 20'	



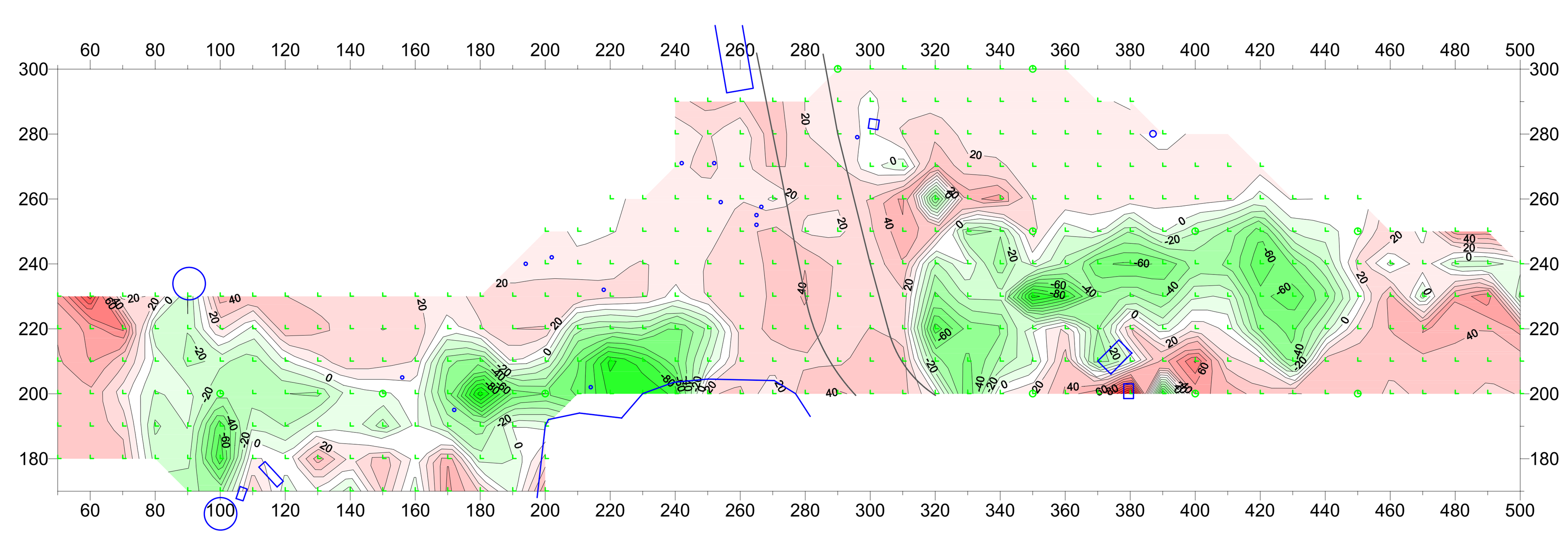
Map showing grid and labeled site features



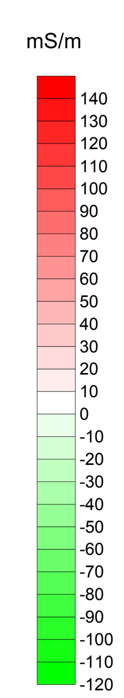
Quadrature Contour Map
Receiver: East



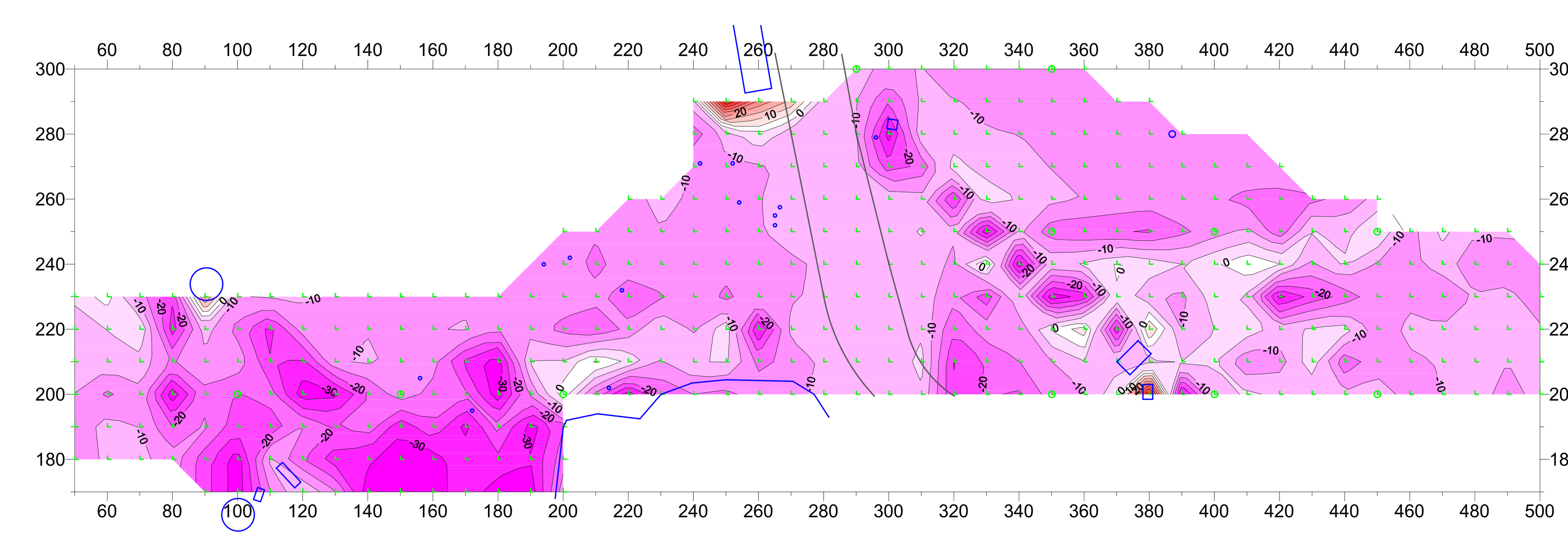
Inphase Contour Map
Receiver: East



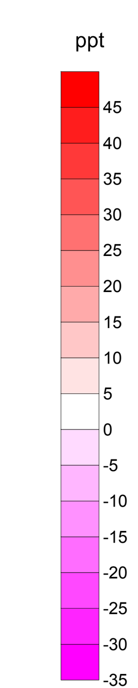
Quadrature Contour Map
Receiver: North
(all acquired May 18)



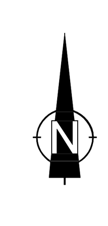
Contour Interval = 10 mS/m



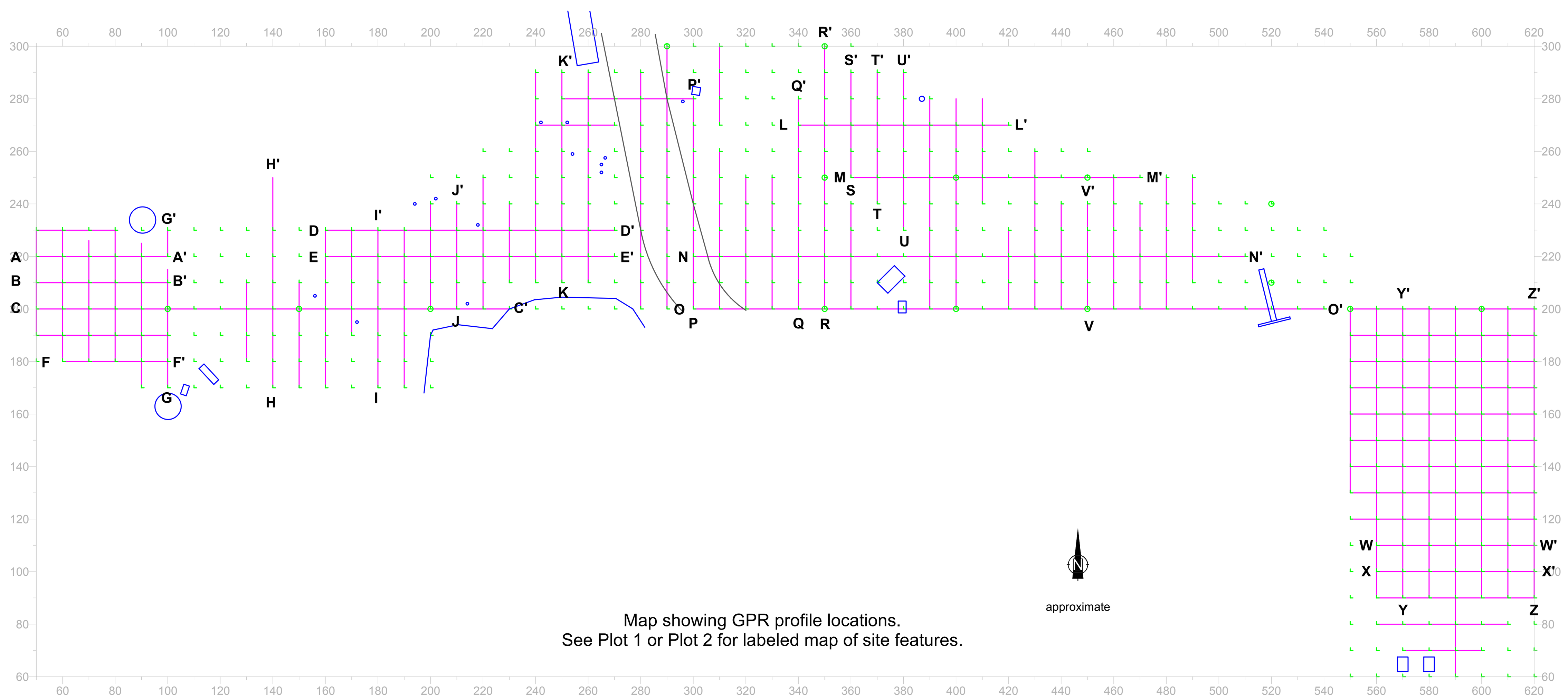
Inphase Contour Map
Receiver: North
(all acquired May 18)

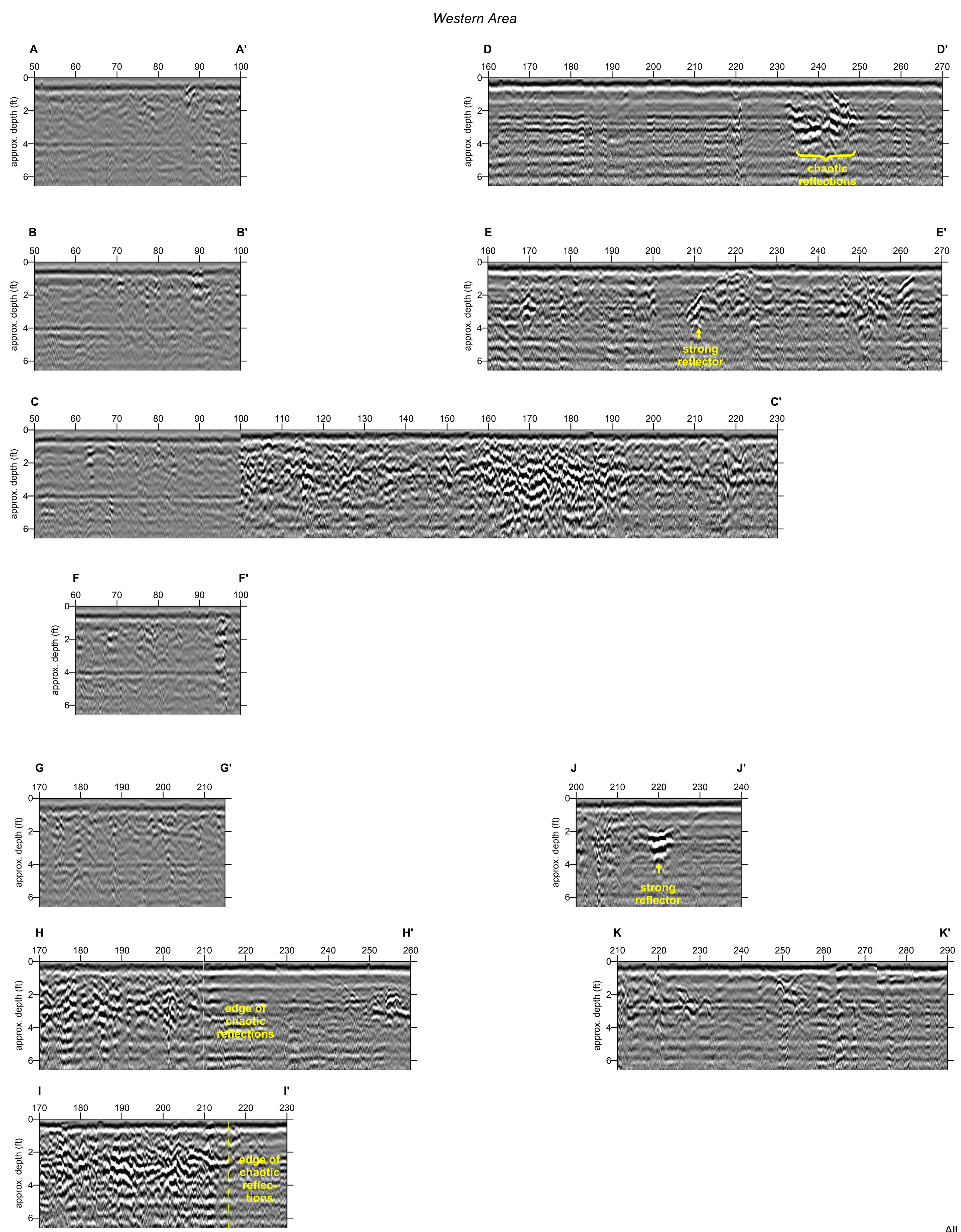


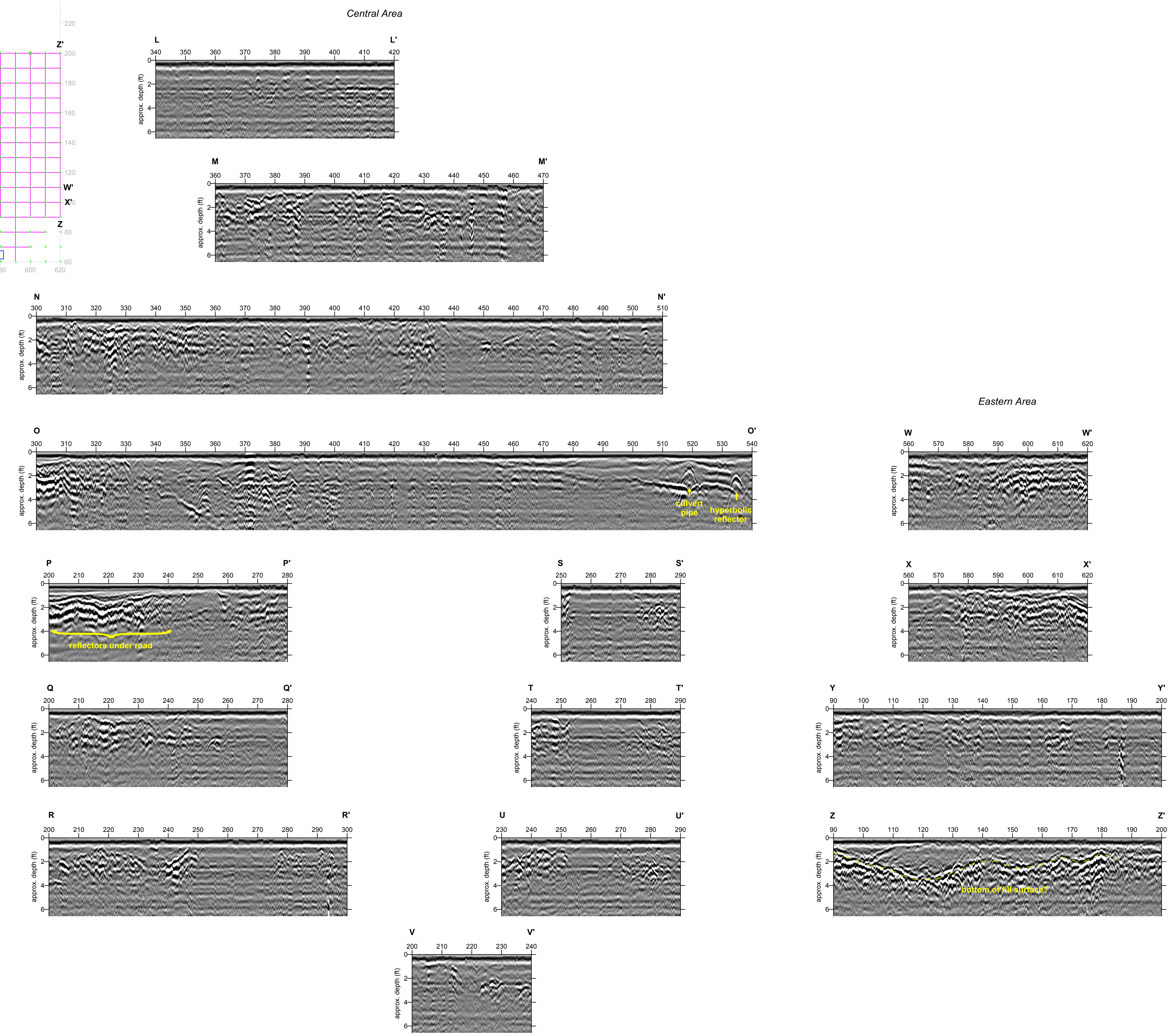
Contour Interval = 5 ppt



Earth Resources Technology	**Quadrature and Inphase Contour Maps** **Site 11 - Caffee Road Landfill** **Indian Head Navy Base, Maryland** **Prepared for CH2M Hill.**	**PLOT 2** June 13, 2006 Scale: 1" = 40'







Profiles acquired using GSSI SIR-3000 Ground Penetrating Radar unit with 400 MHz antenna on May 10 and 18, 2006.
All profiles cropped at 40 ns, and converted to depth in feet assuming 0.1 m/ns of two-way travel time, resulting in total depth of 6.56 feet.

Earth Resources Technology	Map of GPR Profile Locations with Representative Profiles Site 11 - Caffee Road Landfill Indian Head Navy Base, Maryland Prepared for CH2M Hill.	PLOT 3 June 13, 2006 Map Scale: 1" = 40' Profile Horizontal Scale: 1" = 20' Profile Vertical Scale: 1" = 5'

Appendix E
Hydrographic Survey Results and Interpretation

Hydrographic Survey Results, Naval Support Facility, Indian Head, Indian Head, Maryland.

PREPARED FOR: Joe Rail/NAVFAC Washington
Dennis Orenshaw/EPA Region III
Curtis DeTore/MDE
Jeffrey Bossart/NSF-IH
Simeon Hahn/NOAA
Fred Pinkney/FWS

PREPARED BY: CH2M HILL

DATE: March 5, 2008

1.0 Introduction

This Technical Memorandum presents the results of the hydrographic survey performed in Mattawoman Creek area approximately 130 to 180 feet from the shoreline adjacent to Site 11, Caffee Road Landfill, Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland from November 27 to 29, 2007. The objectives of the hydrographic survey were to determine sediment elevations, identify magnetic anomalies, identify areas with surface debris, and map water current velocities in the survey area shown in Figure 1.

The surveys were performed in support of the Feasibility Study (FS) and the remedy design to address contamination in the former landfill and the nearshore sediment (within 10 feet of the shoreline), referred to in Figure 1 as the soil/solid waste area of attainment and nearshore sediment area of attainment, respectively. The remedy for the landfill is a soil cover. Because the landfill abuts Mattawoman Creek, shoreline stabilization is an element of the remedy to be implemented. The proposed shoreline stabilization measure provides a vegetation-based (or "living") shoreline protection to enhance the ecological habitat of the site. The shoreline stabilization measure is proposed to be constructed by extending the soil cover toe into Mattawoman Creek, creating a stable slope for wetland species planting. This measure will indirectly be the remedy for contamination in the nearshore sediment adjacent to the former landfill foot print. As shown in Figure 1, the majority of the nearshore sediment contamination area requiring remediation is adjacent to the former landfill. As for the remaining nearshore sediment contamination area, a gravel blanket is proposed for the remedy. The conceptual design of the shoreline stabilization measure and its rough-order-of-magnitude cost were presented in a technical memorandum entitled "*Comparative Analysis of Shoreline Stabilization and Nearshore Sediment Remediation Alternatives, Site 11, NSF-IH, Indian Head, MD*" that was submitted to the Indian Head Installation Restoration Team on December 3, 2007 (CH2M HILL, 2007).

The results of the hydrographic survey will be used in the FS to develop the conceptual design, to estimate the cost of the shoreline stabilization measure, to calculate design parameters, such as slope stability analysis, and to determine the particle size of the gravel blanket.

2.0 Technical Approach

The surveys were conducted on the area of approximately 1,200 linear feet along the shoreline and between 130 and 180 feet outward into the creek. The hydrographic survey activities consisted of bathymetry, side-scan sonar, magnetometer and current surveys. Photographs of the survey area and survey activities are included in Appendix A. The surveys were performed by C.R. Environmental Inc. of East Falmouth, MA and the report is provided as Appendix B. All survey data was collected in conjunction with real-time Differential Global Positioning System (DGPS) locations and projected in Maryland State Plane (NAD83, WGS84, metric).

The purpose of the bathymetric survey was to measure depth to the sediment surface in Mattawoman Creek. The bathymetric survey was conducted with a single-beam transducer that produced a constant frequency signal to measure the depth of Mattawoman Creek to the closest 0.1 foot. The survey was conducted by continuously recording depth measurements along survey transects parallel to the shoreline that were spaced 10 feet apart. A tidal staff gage was established and surveyed from a known reference elevation from shore, and survey depths were recorded in feet below mean sea level (MSL).

The magnetometer survey was conducted to identify potentially metallic debris. It was conducted simultaneously with the bathymetric survey by deploying a towed magnetometer attached to a flotation device behind the survey vessel at a distance that ensured no interference would be introduced by the survey vessel or its electronics. The magnetometer recorded the total magnetic field intensity for the entire survey area.

A side-scan sonar survey was conducted to assess benthic surface conditions. The survey used a towed sonar apparatus, employing a 500 kilohertz (kHz) signal with a range setting of 82 feet that resulted in an effective resolution of around 5-25 centimeters for sediment features.

The water current velocity in Mattowoman Creek at Site 11 was collected using an Acoustic Doppler Profiler (ADP). The ADP was placed below the hull of the survey vessel and collected data from three beams transmitting from the device at 1,500 kHz. These beams penetrated into the water column and measured the current velocity up to 26.8 feet below the water surface. Data were corrected by internal compass, pitch, and roll sensors for boat motion during data collection. Data were collected from 12 stations located in a grid throughout the survey area. Each of the stations was occupied for at least two minutes and at three different times to allow for water current data collection during rising and falling tides.

3.0 Survey Results

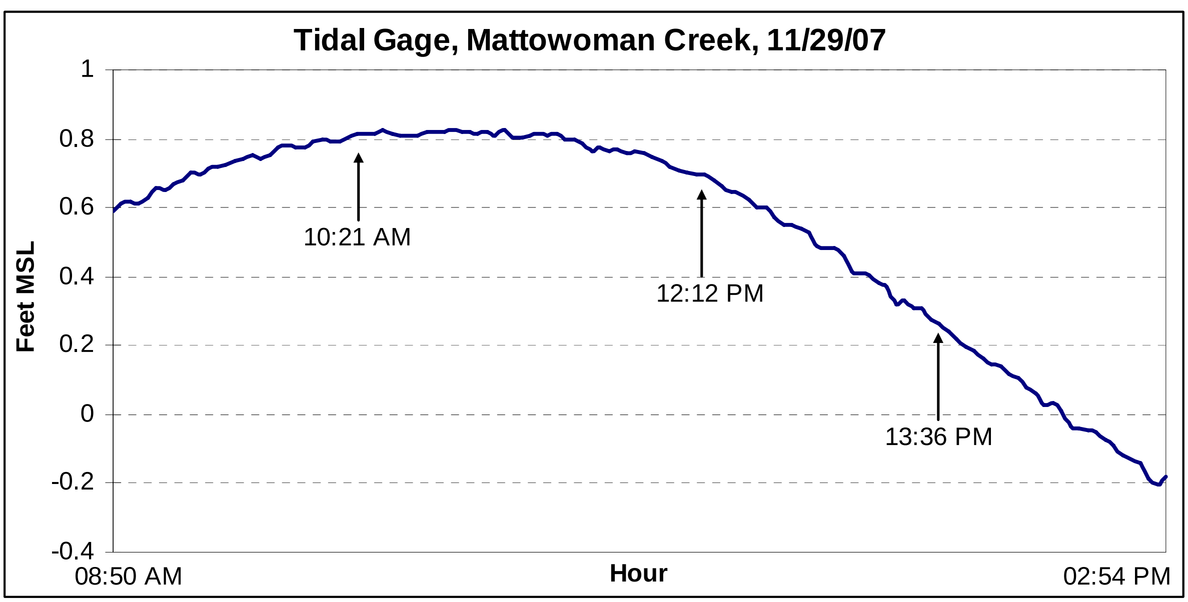
The results of the bathymetric survey are shown on Figure 2. In general, the results indicated that the sediment surface slope is steeper from about the center to the east along the edge of Mattawoman Creek than the west. Depths recorded in the survey ranged from

3.4 to 12.9 feet below MSL. Bathymetric contour lines from 4 feet to MSL were interpolated as an approximation of the slope at the shore line (Figure 7). A geologic cross-section prepared along the existing transect line C-C′ from the Remedial Investigation (Figure 7), was extended into Mattowoman Creek and is presented in Figure 8.

Results of the survey are presented in Figure 3. The results identified an area with an elevated magnetic field in the western portion of the site entering Mattowoman Creek. Several specific areas of elevated magnetic fields were identified as anomalies and are shown as stars in Figure 3. Some of these anomalies are associated with side-scan sonar targets, which have a distinct reflection above the sediment surface. The majority of magnetic anomalies shown in Figure 3 are outside the nearshore sediment area of attainment shown in Figure 1.

Results of the side-scan sonar survey are shown in Figure 4 and the overlay of the bathymetric survey and side-scan sonar survey results is shown in Figure 5 in Appendix B. This figure also shows areas with angular material above the sediment surface extending from Site 11 into the navigational channel. Some individual objects, such as the one near the center of Figure 5 in Appendix B are as long as 25 feet and extend 1 foot above the creek floor. The area with the steepest slope identified in the bathymetric survey also has debris visible into the navigational channel, as annotated in Figures 5 and 7 in Appendix B.

Figures 5 and 6 show the average velocity ADP and deep velocity ADP results, respectively. The average velocity vector is measured by the ADP over the water column whereas the deep velocity is measured nearest the creek bed. The following graph shows the tidal gage for Mattawoman Creek during the time of the ADP survey and the times where ADP measurements were taken. The graph indicates that the current velocity measurements were taken to represent different parts of the tidal cycle.



The hydrographic survey could not be conducted to the west and east of the proposed survey area because of the presence of dense submarine aquatic vegetation (SAV), which appears just below the intertidal zone at these locations (Figure 9). Based on the tidal information collected from the Potomac River at Indian Head (Potomac River Lower Cedar Point to Mattawoman Creek) presented in the National Oceanic and Atmospheric Administration Navigation Chart No. 12288, the intertidal zone at the site extends offshore to an elevation of 0.9 feet below MSL or approximately the 1 feet below MSL contour line shown on Figures 7 and 9.

4.0 Conclusions

Based on the hydrographic survey results, it is now known that the nearshore (0 to 10 feet) creek bed is substantially steeper than initially assumed during the initial shoreline stabilization conceptual design. The creek bed drops from 0 to 6 feet below MSL in less than 20 feet and then to 8 feet below MSL within 60 feet of the shoreline. As a result, significant modification to the shoreline stabilization conceptual design is necessary to incorporate this additional information. The modification includes increasing the volume of rock fill required for the construction of the underwater landfill toe foundation and extending the foundation of the landfill toe further into the creek to accommodate a stable slope. Based on the current site condition, a 3H:1V slope will extend the foundation of the landfill toe by approximately 40 feet into the creek from the shoreline. These modifications will result in an increase in construction cost. The concern with the remedy incorporating these modifications is the potential impact of the extension of the landfill toe in the creek to the navigable channel.

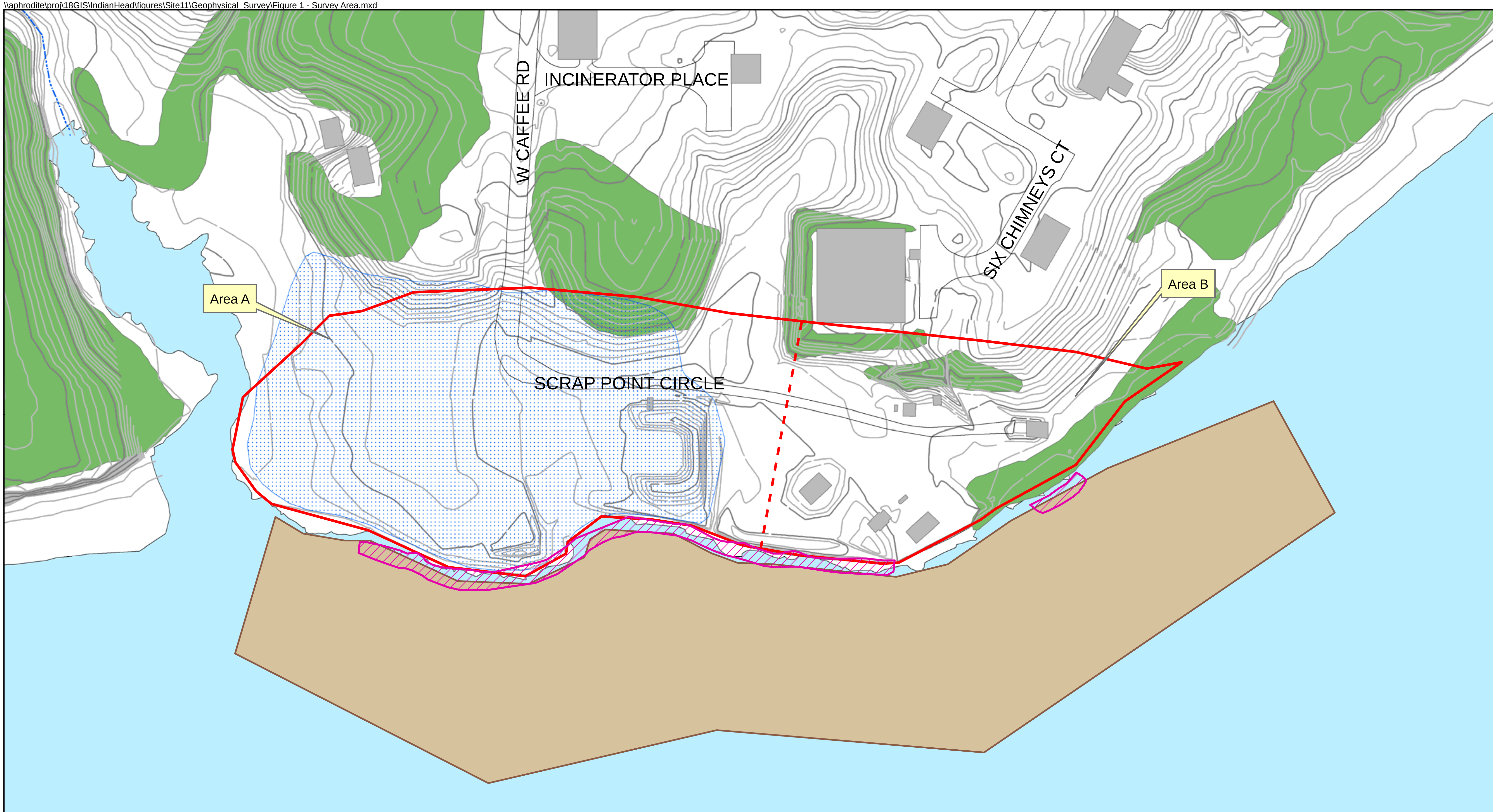
5.0 References

CH2M HILL, 2004. *Final Remedial Investigation Report, Sites 11, 13, 17, 21, and 25, Indian Head Division–NSWC, Indian Head, Maryland*. April.

CH2M HILL, 2007. *Final Feasibility Study Sites 11, Naval Support Facility-Indian Head, Indian Head, Maryland*. August.

Figures

\\aphrodite\proj\18GIS\IndianHead\figures\Site11\Geophysical_Survey\Figure 1 - Survey Area.mxd



Legend

- Approximate Site Boundary
- Buildings
- Wooded Area
- Roads
- Hydrographic Survey Area
- Sediment Area of Attainment
- Soil/Solid Waste Area of Attainment
- Boundary Between Area A and Area B
- Stream

Figure 1
Hydrographic Survey Area
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

CH2MHILL

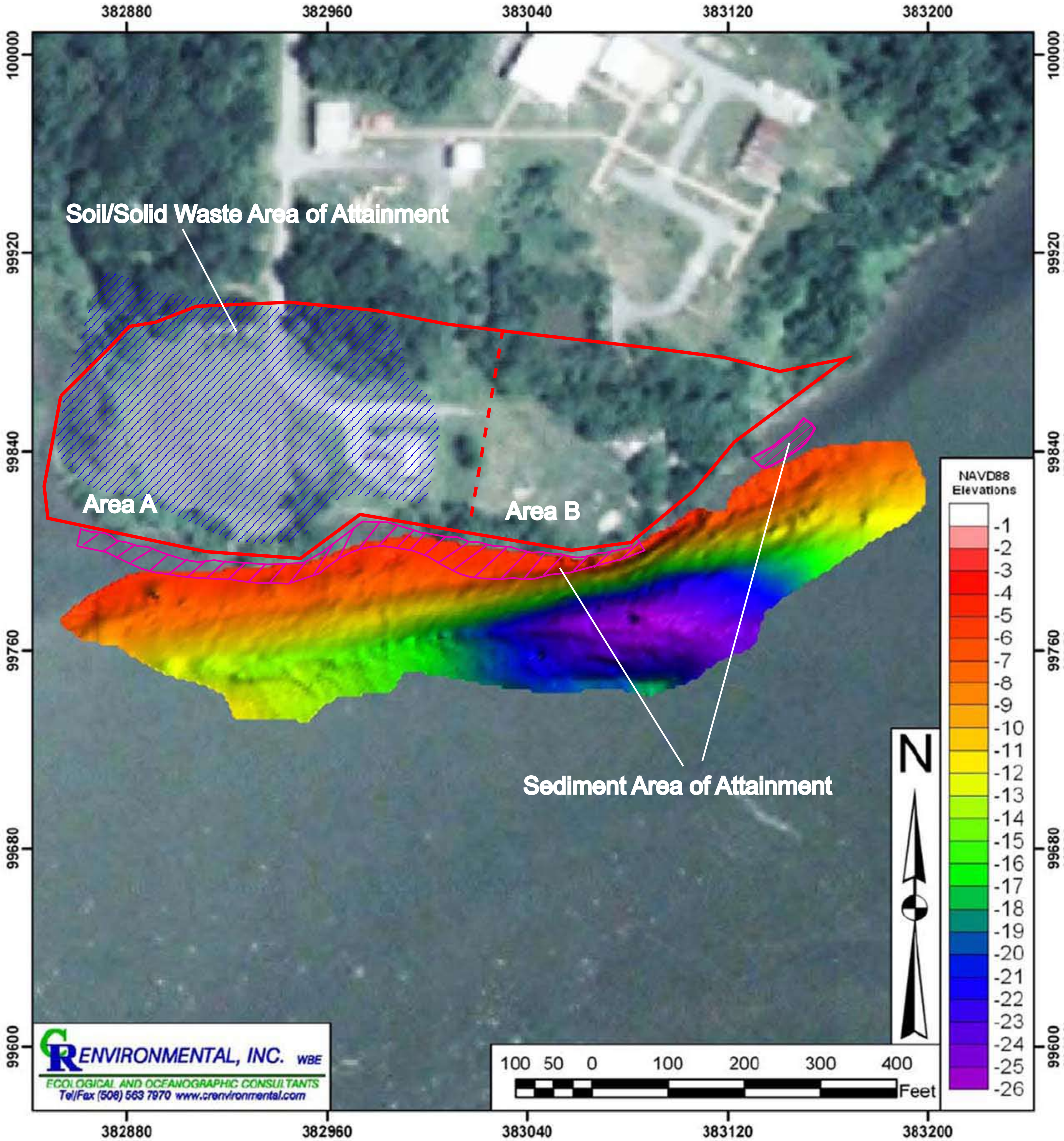
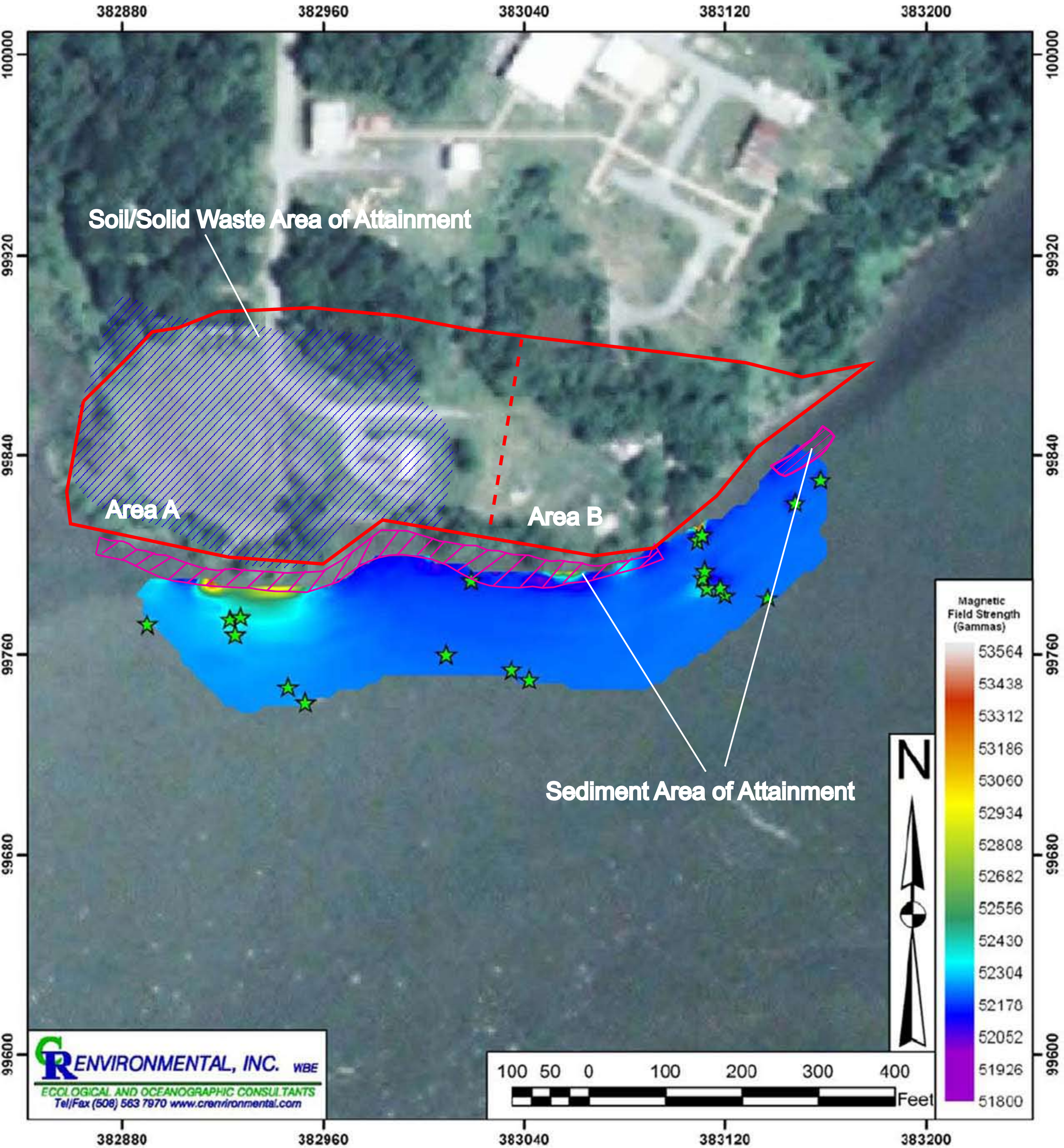


Figure 2
Vertically Exaggerated Relief Bathymetry Survey Results
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

Note: Coordinates in Maryland State Plane, NAD83, Meters. Depths are in U.S. Survey Feet, NAVD88.

CH2MHILL



Stars indicate magnetic anomaly

Figure 3
Magnetometer Survey Results
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

Note: Coordinates in Maryland State Plane, NAD83, Meters. 1 Gamma=1 nanoTesla

CH2MHILL

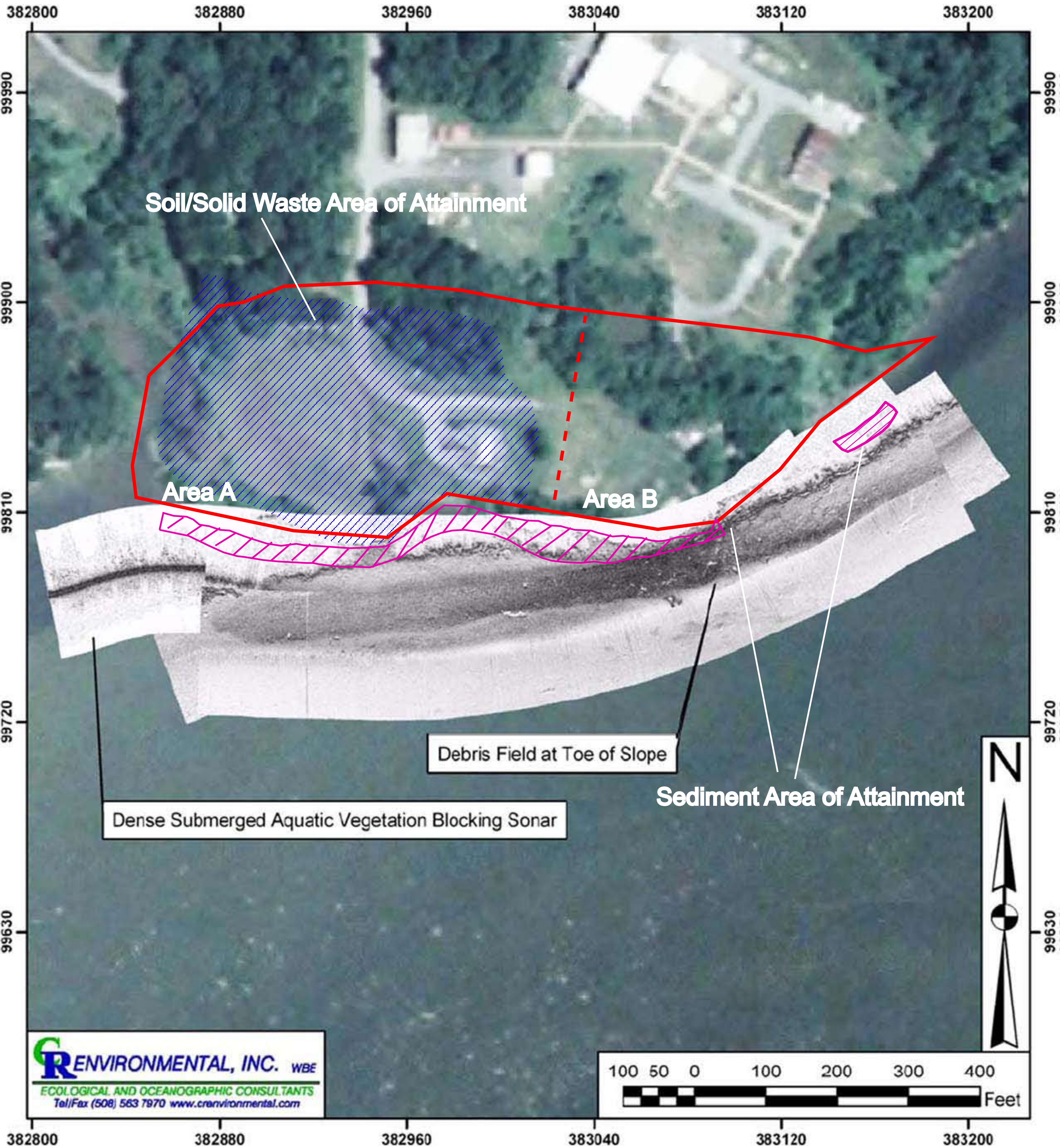


Figure 4
Side-Scan Sonar Survey Results
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

Note: Coordinates in Maryland State Plane, NAD83, Meters.

CH2MHILL

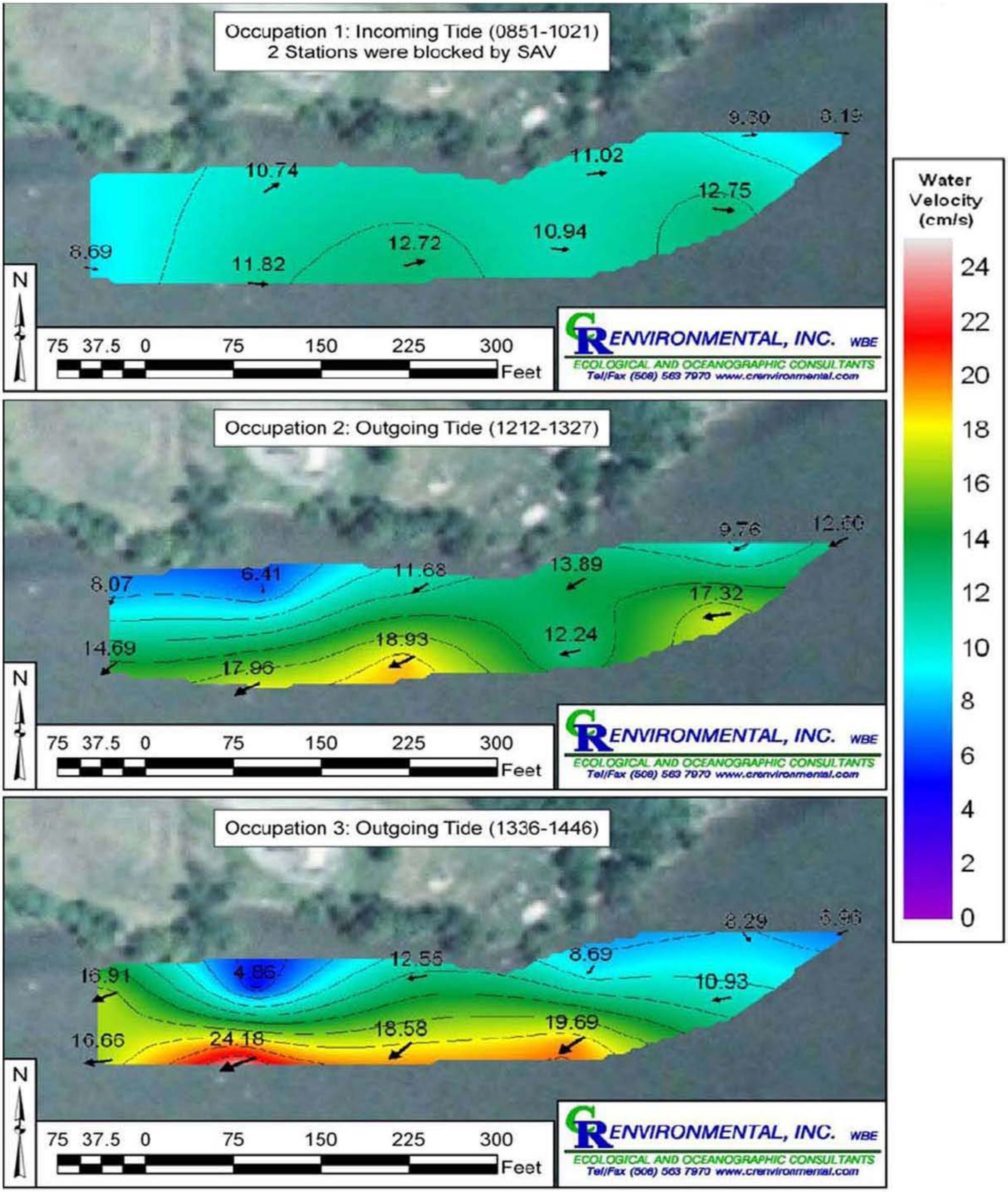


Figure 5
Average Velocity Acoustic Doppler Profiler Results
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

Note: Survey conducted on November 29th, 2007. Current velocity interpolated between survey stations.

CH2MHILL

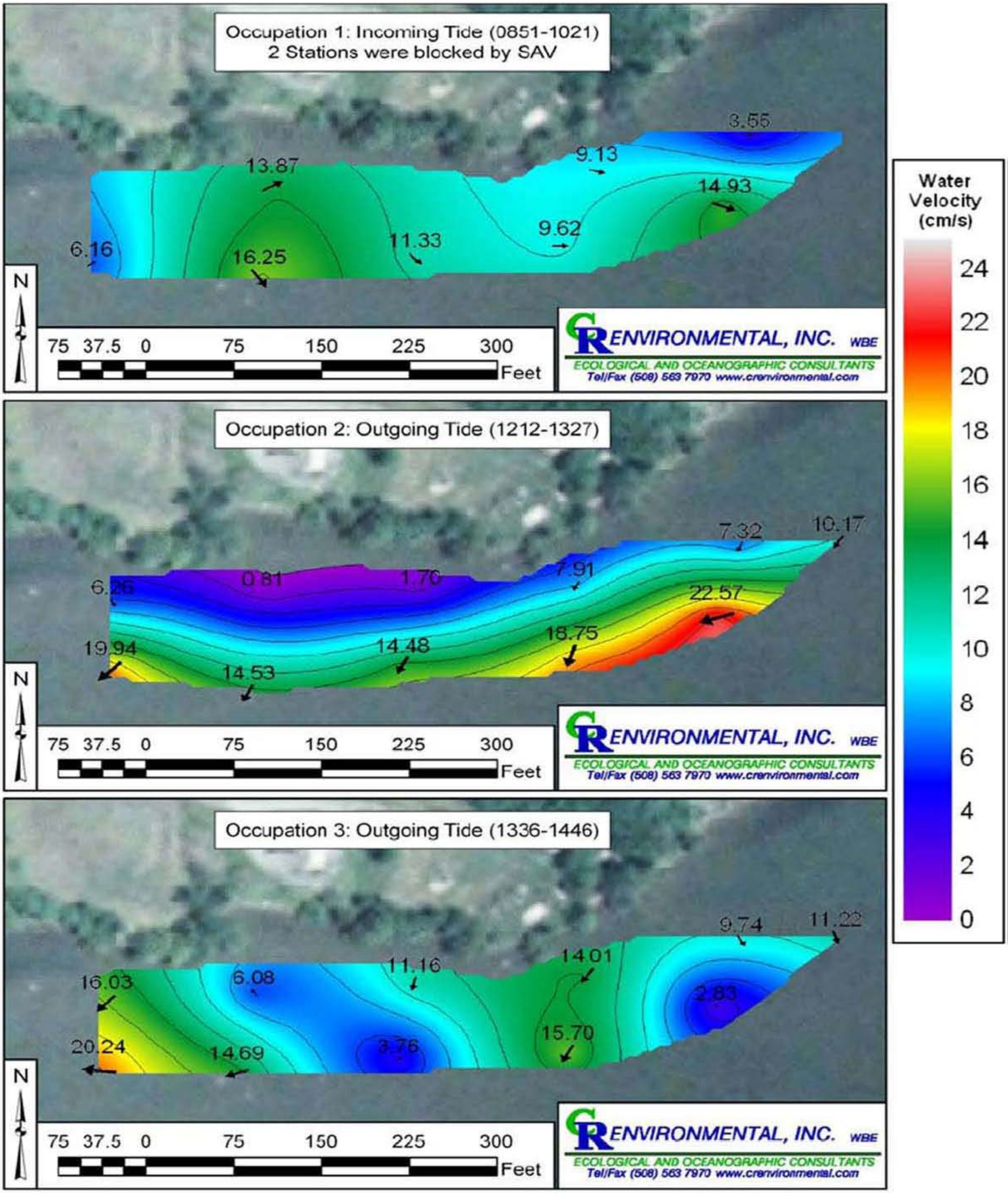


Figure 6
Bottom Cell Velocity Acoustic Doppler Profiler Results
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

Note: Survey conducted on November 29th, 2007. Current velocity interpolated between survey stations.

CH2MHILL

\\aphrodite\proj\18GIS\IndianHead\figures\Site11\Geophysical_Survey\Figure 7 - Batheymetry and Geologic Cross Section Area.mxd

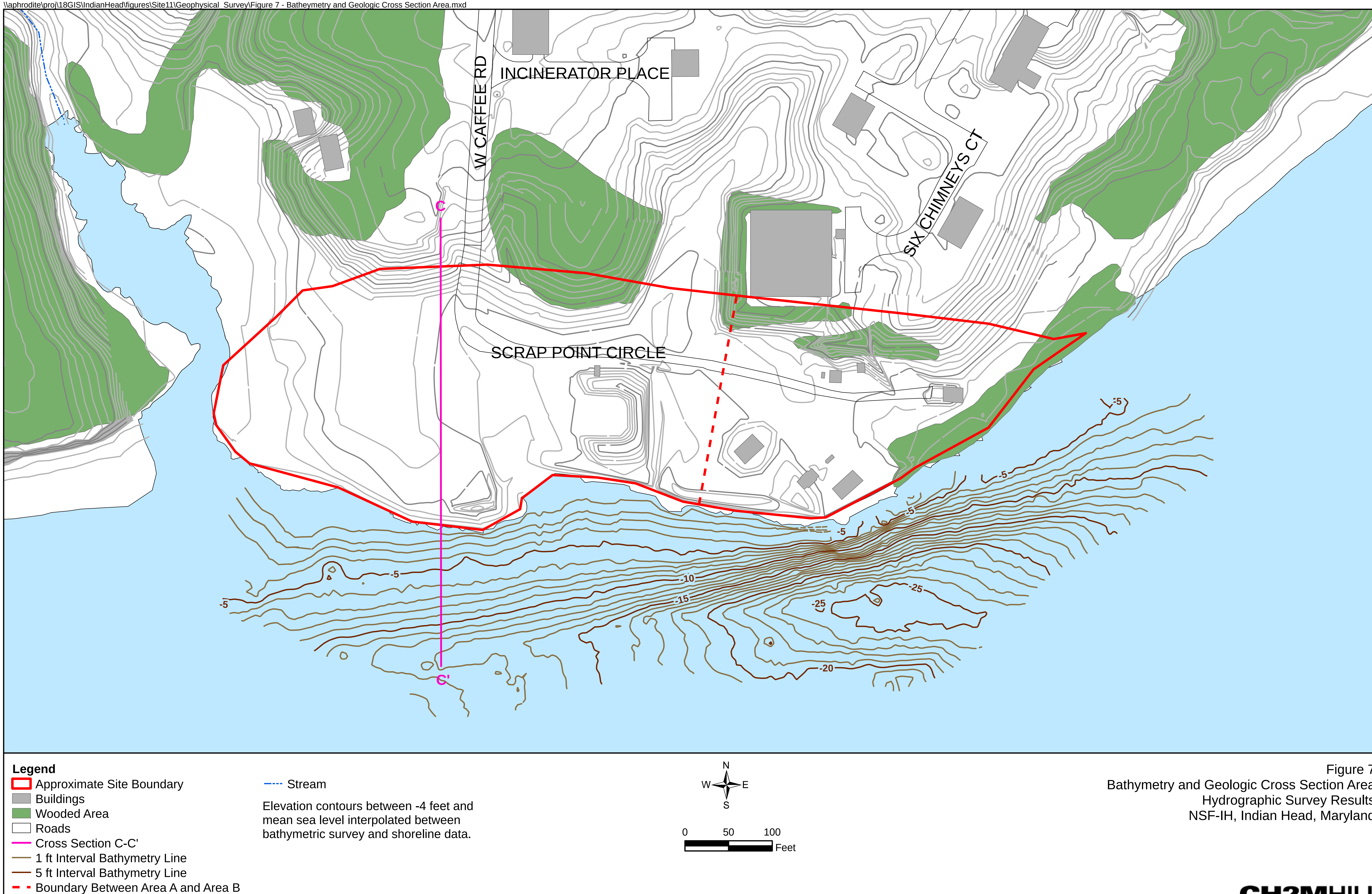


Figure 7
Bathymetry and Geologic Cross Section Area
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

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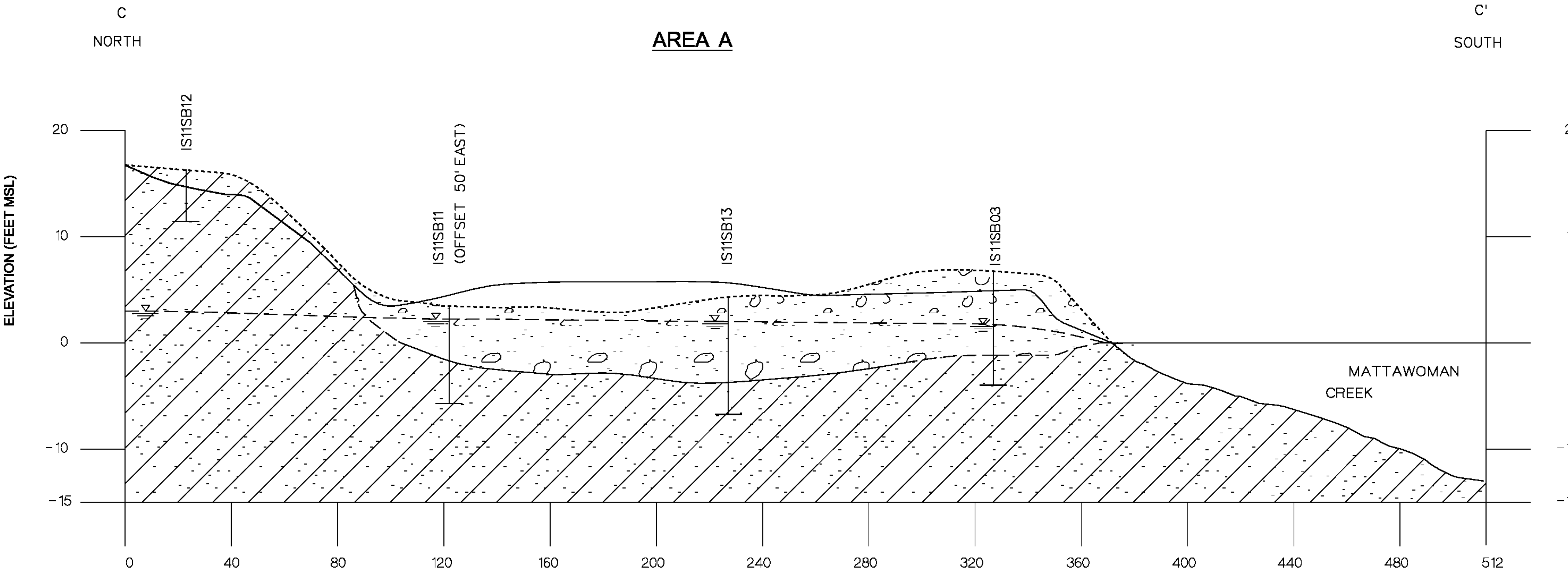
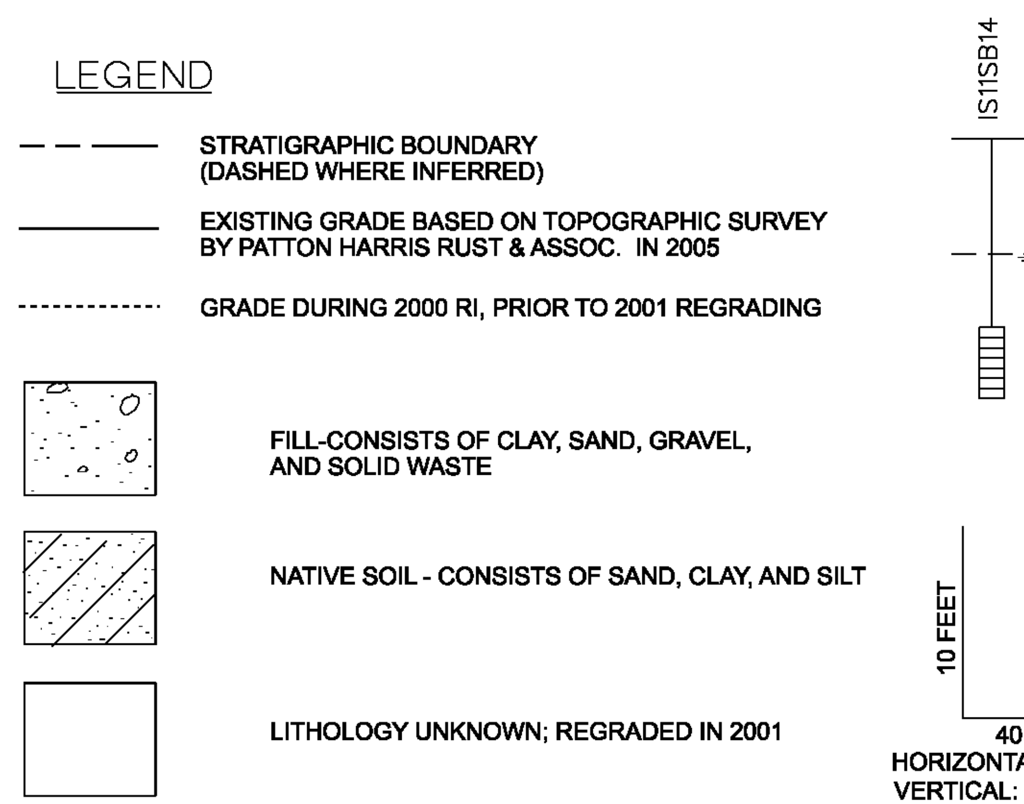
AREA A



NOTE:

1. MONITORING WELLS WERE SURVEYED BY BALDWIN AND GREGG IN DECEMBER 2000.
2. SOIL BORING LOCATIONS WERE SURVEYED WITH A GPS UNIT BY CH2M HILL; AREA A BORINGS IN 2000 AND AREA B BORINGS IN 2002
3. TOPOGRAPHIC BASE FEATURE TAKEN FROM MICRO STATION FILES SUPPLIED BY PATTON HARRIS RUST & ASSOC.,PC DATED JULY 26, 2005
4. SECTION PROFILE REPRESENTS SLOPE CONDITION AT CROSS SECTION A-A' , B-B', C-C', D-D'. SEE FIGURE 1-3 FOR LOCATION OF ALL CROSS SECTIONS.
5. LOCATION OF SUBSURFACE STRATUM BOUNDARIES HAVE BEEN INTERPOLATED FROM INFORMATION OBTAINED AT LOCATION OF BORINGS. ACTUAL CONDITION BETWEEN BORINGS MAY BE DIFFERENT THAN SHOWN ON THE CROSS SECTION. SEE APPENDIX A IN THE RI (CH2M HILL, 2004) FOR LOGS.
6. HORIZONTAL DATUM MARYLAND STATE PLANE NAD 83 AND VERTICAL DATUM NAVD 88
7. SOLID WASTE CONSISTS OF BRICK, CONCRETE, TIRE, METAL DEBRIS, SLAG, UNDIFFERENTIATED RUBBLE & DEBRIS, TREATED WOOD AND WOOD PIECES. DESCRIPTION OF THE SOLID WASTE IS TAKEN FROM THE BORING LOGS.
8. INFERRED GROUNDWATER ELEVATION BASED ON WATER LEVELS MEASURED IN MARCH 2002 POTENTIOMETRIC SURFACE ELEVATION CONTOURS (FIGURE 1-7 IN THE FS REPORT).
9. BATHYMETRIC ELEVATIONS IN MATTOWOMAN CREEK SUPPLIED BY CR ENVIRONMENTAL, DATED NOVEMBER 28, 2007. ELEVATIONS BETWEEN MEAN SEAL LEVEL AND 4 FEET BELOW SEE LEVEL ARE INTEROPOLATED.

LEGEND



STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)

EXISTING GRADE BASED ON TOPOGRAPHIC SURVEY BY PATTON HARRIS RUST & ASSOC. IN 2005

GRADE DURING 2000 RI, PRIOR TO 2001 REGRADING

FILL-CONSISTS OF CLAY, SAND, GRAVEL, AND SOLID WASTE

NATIVE SOIL - CONSISTS OF SAND, CLAY, AND SILT

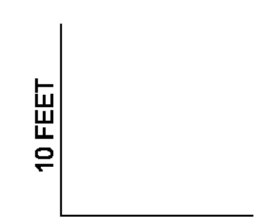
LITHOLOGY UNKNOWN; REGRADED IN 2001

SAMPLE POINT (WITH PROJECTED DISTANCE, IF ANY)

SOIL BORING OR MONITORING WELL

INFERRED GROUNDWATER LEVEL (ELEVATION IN FEET-NAVD 88)

MONITORING WELL SCREENED INTERNAL

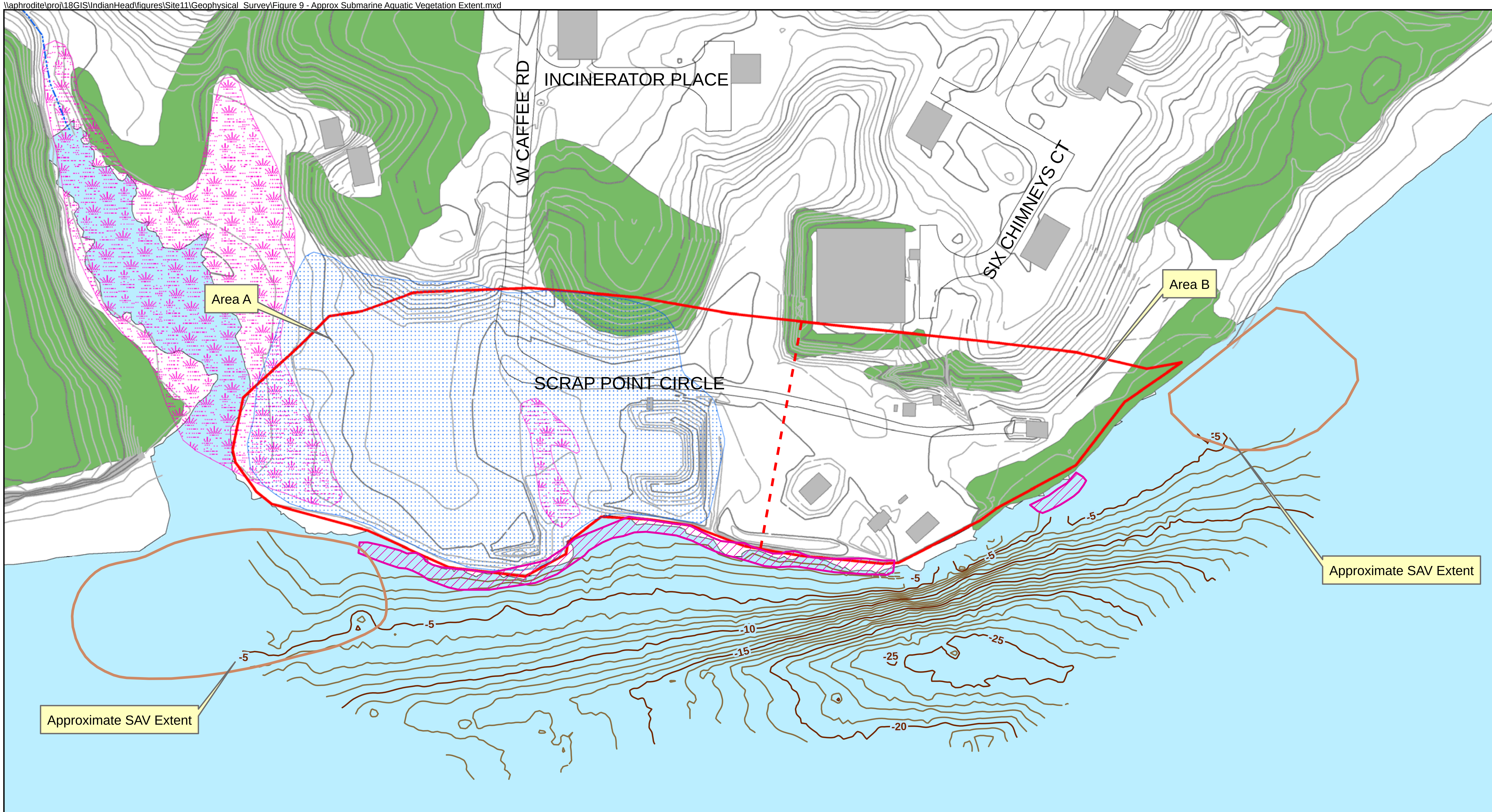


HORIZONTAL: 1" = 40'
VERTICAL: 1" = 10'

Figure 8
GEOLOGIC CROSS SECTION
HYDROGRAPHIC SURVEY RESULTS
NSF-IH, INDIAN HEAD, MARYLAND

CH2MHILL

\\aphrodite\proj\18GIS\IndianHead\figures\Site11\Geophysical_Survey\Figure 9 - Approx Submarine Aquatic Vegetation Extent.mxd



Legend

- Sediment Area of Attainment
- Wetland Areas
- Soil/Solid Waste Area of Attainment
- Approximate Site Boundary
- Buildings
- Wooded Area
- Roads
- 1 ft Interval Bathymetry Line
- 5 ft Interval Bathymetry Line
- Boundary Between Area A and Area B
- Stream

Elevation contours between -4 feet and mean sea level interpolated between bathymetric survey and shoreline data.

N W E S

0 50 100 Feet

Figure 9
Approximate Submarine Aquatic Vegetation Extent
Hydrographic Survey Results
NSF-IH, Indian Head, Maryland

CH2MHILL

Appendix A
Hydrographic Survey Photographs

Site 11 viewed from the south shore of Mattowoman Creek @ Smallwood State Park

Side-Scan Sonar Towfish

Acoustic Doppler Current Profiler

Shore view near the center of the survey area, outside the sediment area of attainment.

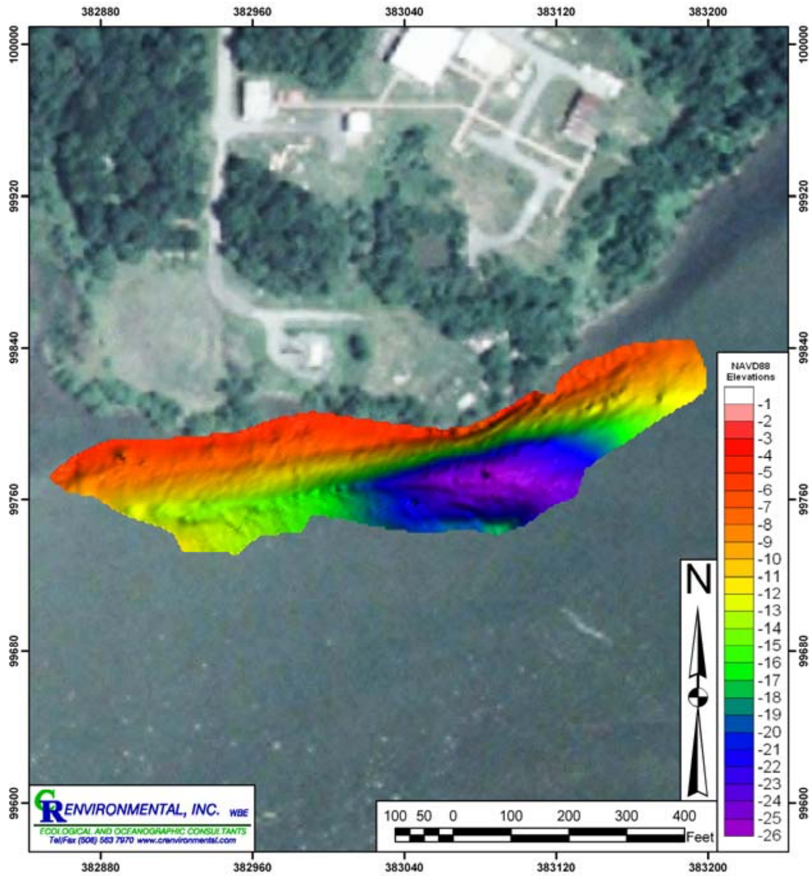

Current near shore conditions on the western side of the site.


View of anthropogenic debris visible at low tide, western side of the site.

Appendix B
C.R. Environmental Inc. Hydrographic Survey Report

GEOPHYSICAL AND CURRENT STUDIES

AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MARYLAND



Notes: Coordinates in Maryland State Plane, NAD83, Meters. Depths are in U.S. Survey Feet, NAVD88.

Bathymetric Surface Map Area A: Mattawoman Creek

Prepared by:

CR Environmental, Inc.
639 Boxberry Hill Road
East Falmouth, MA 02536

Prepared for:

CH2M Hill
15010 Conference Center Drive
Suite 200
Chantilly, VA 20151

January 2008

TABLE OF CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

Mattawoman Creek, located 20 miles south of Washington D.C., near the town of Indian Head, Maryland, is a tributary of the Potomac River and the Chesapeake Bay. CR Environmental, Inc. (CR) performed hydrographic, magnetic, side scan sonar and water flow surveys near the northern shore of Mattawoman Creek, abutting Area A, part of the Indian Head Division, Naval Surface Warfare Center (IHDIV/NSWC) (Figure 1). The survey was conducted for CH2M Hill from November 27 through 29, 2007. CR's survey area extended beyond the specified area in the request for proposal (i.e. 1000 ft long and 100 ft from shore) and covered an area 1200 feet by 130 to 180 feet. The surveys were conducted in support of CH2M Hill's investigation of the Naval facility's shoreline for possible capping and dredging. The goals of the acoustic surveys were to:

- Determine bottom elevations (bathymetry);
- Locate and map the extent of magnetic anomalies associated with ferrous debris using a high-sensitivity magnetometer;
- Conduct sediment characterization and map the extent of surficial debris using side scan sonar;
- Map water current velocities and directions in this portion of the creek using a high frequency Acoustic Doppler Profiler (ADP).

This report details the methods used to acquire and process remote sensing data. The survey results are presented and discussed, and digital versions of the survey data in several formats suitable for use with GIS and CAD software are provided on DVD.

2.0 SURVEY VESSEL

The survey operations were performed from CR's 14-ft aluminum survey vessel. This vessel is equipped with a 10 hp, 4 cycle gasoline outboard, instrument enclosure, over-the-side transducer mounts, 1kW sine-wave inverter, 12v power, and a GPS antenna bracket.

3.0 NAVIGATION AND SURVEY CONTROL

Navigation for the surveys was accomplished using a Trimble AgGPS 132 12-channel Differential Global Positioning System (DGPS) capable of receiving the U.S. Coast Guard (USCG) beacon corrections and the OMNISTAR subscription-based satellite differential correction service. The DGPS provided a 1 Hz digital output of positions accurate to less than 1.0 meter horizontally. The DGPS system was interfaced to a laptop computer running HYPACK hydrographic survey software. HYPACK continually recorded vessel position and depth data in Maryland State Plane (NAD83, WGS84, metric) and provided a steering display for the vessel captain.

Vertical control for the bathymetric survey was provided by installation of a tide staff on a ladder overhanging the water in the middle of the survey area. This staff was surveyed using a laser level placed on shore and aligned with the top of monitoring well MW-03. CH2M Hill's onsite representative provided an elevation for this well in NAVD88. Tide readings were taken regularly during the hydrographic survey operations.

4.0 SURVEY METHODS

4.1 Survey Design

The geophysical survey was designed to meet or exceed hydrographic survey standards promulgated by the U.S. Army Corps of Engineers (ACOE, EM-1110-2-1003). Survey transects were designed using HYPACK hydrographic survey software. Background imagery including a georeferenced orthophoto and polygons representing survey boundaries were imported to HYPACK to guide the survey design. Transects for the survey area were established using 10-ft (on-center) spacing oriented parallel to the shore. Additional transects were designed perpendicular to the shore to provide overlapping data points and allow for quality control of the bathymetric data.

4.2 Bathymetric Data Acquisition

The bathymetric data acquisition system consisted of a laptop computer running HYPACK, a SyQwest, Inc. Bathy500-DF precision single-beam echosounder, and a Trimble AgGPS 132 DGPS. The echosounder and DGPS were interfaced to the survey computer via RS-232 serial ports. The survey was conducted using a single frequency transducer (200-kHz, 8-degree beam), after determining that there was not a significant flocculent layer of sediment, which would have required the use of a dual-frequency transducer. The accuracy of the Bathy500 is approximately 0.1% of the water depth with a resolution of 0.1 ft. System accuracy was checked at the start and end of each survey day by comparing echosounder water depth measurements to known water depths. Known water depths were obtained using the "bar check" method, in which a metal plate was lowered beneath the echosounder's transducer to several known distances (e.g., 5, 10, 15 and 20 ft) below the surface of the water. Based on these comparisons, the echosounder was calibrated for site-specific sound velocity. "Bar-check" calibrations were consistently accurate to within 0.1 ft throughout the survey. Sound velocity was also calculated using temperature and conductivity measurements obtained using an InSitu Troll9000 water column profiling instrument. A sound velocity profile was calculated using the Chen equation (Chen, C.T. and F. J. Millero. 1977. *Speed of Sound in Seawater at High Pressures*. J. Acoust. Soc. Am. 32(10), p. 1357). This calculated sound velocity matched the sound velocity entered in the echosounder.

4.3 Bathymetric Data Processing

Bathymetric data were processed using the HYPACK Single-Beam Editor Module. Components of bathymetric processing included removal of outlying soundings associated with water column interference (e.g., aquatic vegetation or mid-water column debris) and conversion of soundings to NAVD88 elevations based on reported water elevation data.

The processed bathymetric data were combined into a single comma-delimited ASCII text file including fields for Northing, Easting, and elevation. This combined data set was imported to Golden Software, Inc. Surfer V.8.1 Surface Modeling Software. Grids of the creek bottom elevations were created for each survey area using triangulation interpolation methods and a 1.5

meter grid node interval. Contour maps depicting bottom elevations using 1.0 ft contour intervals were created from these grids. Surface maps with a ten-fold exaggeration of height were also created from these grids. These maps were imported into ArcGIS 9.2 and a plan of survey area bathymetry was created. Bathymetric data, in the form of AutoCAD DXF's, shaded GeoTiff files of both the contour and surface data (with accompanying color scales), and ASCII depth file are available on the Data DVD in the Bathymetric Data folder.

4.4 Magnetometer Data Acquisition

The Magnetic Survey was conducted simultaneously with the bathymetric survey along the same set of survey transects. Magnetic data were acquired using a Marine Magnetics, Inc. Mini Explorer high resolution marine magnetometer system. The magnetic data acquisition system consisted of towfish-mounted Overhauser magnetic sensor and a pressure/depth sensor, an onboard power supply and serial interface, and a data acquisition computer. The 1 Hz data stream from the magnetic sensor was routed to the HYPACK navigation computer via serial port. HYPACK recorded magnetic readings in gammas (1.0 gamma = 1 nanoTesla) as a separate field within the same raw data file containing bathymetric soundings. The position of the magnetometer towfish was calculated in real-time using a HYPACK mobile device driver which considered "cable out" relative to the DGPS antenna, the cable catenary curve, and the effects of vessel course corrections.

The magnetometer towfish was kept as close to the creekbed as practical. In deeper areas, the fish was allowed to sink ~10-ft below the water surface, but in shallower water the fish was towed at the surface. The sensor was consistently deployed at a great enough distance from the survey vessel to preclude the potential for magnetic interference from the hull or the vessel's electronics.

4.5 Magnetometer Data Processing

Magnetometer data were processed using HYPACK's Single-Beam Editor Module. Each magnetic survey transect was first inspected in profile format for characteristic signals which indicate the presence of magnetic anomalies. Observed anomalous signals were digitized to an ASCII database including fields for position, approximate magnitude (in gammas), and shape. Signal shape classifications included dipolar (DP, a sine-wave response curve), Monopolar positive (MP+) and Monopolar negative (MP-).

After inspecting each data file and digitizing anomalies, magnetic measurements were merged into a single ASCII comma-delimited database containing all total field (TF) magnetic intensity measurements for the entire survey area. The database contained fields for Northing, Easting, and magnitude. This combined data set was imported to Golden Software, Inc. Surfer V.8.1 Surface Modeling Software. A grid of magnetic intensity was created using Kriging interpolation methods and a 3 meter node interval. A contour map was created from this grid depicting TF magnetism using a 5-gamma[1] contour interval and the map was exported in DXF format. A second map was created using spectrum shading and a 1-gamma and this map was exported as a georeferenced TIF image file. An ArcGIS shapefile was created that also has each anomaly and associated Gamma value noted. These files (DXF contours, GeoTiff with scale, and ArcGIS shapefile) are available on the Data DVD in the Magnetic Data folder.

4.6 Side Scan Sonar Data Acquisition

Side-scan sonar data were acquired using an Edgetech, Inc. Model 560 system. The system consists of an Edgetech 272 TD towfish interfaced to a topside processor via an Analog Control Interface (ACI) circuit. The ACI allowed adjustment of both port and starboard signal gains as judged necessary by the sonar operator. Control of the ACI and sonar signal settings was accomplished using Chesapeake Technology, Inc. SonarWizMAP acquisition software.

Sonar data for the survey area was collected using a 500 kHz signal and 82 foot (25 meter) range setting. The length of towfish cable let out relative to the DGPS antenna (i.e., layback) was set to zero, as the towfish was suspended directly beneath the antenna.

[1] 1 gamma = 1 nanoTesla

All data was archived to a removable hard drive at the end of the survey day. Draft sonar mosaics were produced at the end of the survey to ensure adequate survey coverage and to allow identification of noteworthy features.

4.7 Side Scan Sonar Data Processing

Sonar data were processed using two Chesapeake Technology, Inc. software packages, SonarWeb and SonarWiz. SonarWeb was used to create sonar mosaics, HTML navigable data files and GIS formatted navigation shapefiles. Processing of raw side-scan sonar data in SonarWeb consisted of corrections for towfish layback (i.e., the distance between the towfish and the DGPS antenna), adjustments of data for signal attenuation, and georeferencing of sonar imagery (i.e., projection of the sonar data into real-space coordinates). First, water column portions of the acoustic returns were removed through inspection and processing of each survey transect. The raw data were then corrected by calculating and applying accurate layback and catenary coefficients to each of the data files. Layback and catenary (i.e., factor corresponding to the approximate degree of cable curvature) corrections were calculated from the recorded “cable out” using a simple trigonometric function and the height of the towfish above the seabed. Data were then adjusted for signal attenuation with distance using moderate Time Varied Gain Corrections - TVG. Georeferenced mosaics and transect data were created from the processed data. SonarWiz was used to generate additional mosaics, and for target identification and measurement.

Sonar resolution is defined as the ability of the sonar system to discriminate between two adjacent objects of a particular size and separation. This resolution decreases with increasing range from the sensor due to signal spreading. The theoretical resolution of the side scan sonar data is determined by swath width (range setting), frequency, beam width, ping duration, and vessel speed. Data collected using a 500 kHz signal and 25 meter range has a resolution of approximately 5 – 25 cm. The resolution of georeferenced imagery was set to 0.15-ft per pixel (about 5 cm). Note that sonar waterfall imagery resolution was not constrained by this pixel size determination.

Side-scan sonar data processed in SonarWeb have been delivered in several forms including: georeferenced JPG files, high-resolution annotated “waterfall” imagery (uncorrected raw data) of each survey lane, and GIS shapefiles (polygons) of transect navigation data, with the width of the polygons corresponding to sonar range settings. Also, a set of HTML files for the project was created, allowing Web-browser (i.e., Internet Explorer or Firefox) access to all survey data and imagery. Georeferenced sonar data were incorporated in a GIS database for comparison with other data. Because of the degree of overlap between navigation polygons, the navigation shapefiles are best queried and analyzed in ESRI ArcMAP 9.0 (or later). It is also important to note that while the mosaics produced for this report included all projected sonar files, users of ArcMAP can create customized mosaics of areas of specific interest by selectively adding data for individual transects and adjusting image transparency and contrast. In some instances, selective removal of the extensively overlapped sonar data may result in a “clearer” image. Two mosaics were produced in SonarWeb, one that is clearest near the shoreline, and one that depicts the channel in more detail. These mosaics are viewable individually by selecting one or the other in the HTML project’s index page, found in the Side Scan Sonar Data folder on the Data DVD.

4.8 ADP Data Acquisition

Flow measurements were collected with a Sontek 1,500 kHz Acoustic Doppler Profiler (ADP) interfaced to the Trimble AG 132 DGPS. The ADP was pole mounted with the sensor transducers offset 0.8 ft below the water surface to preclude interference from the vessel’s hull. The ADP compass and pitch/roll sensors were calibrated prior to acquisition.

ADP data were collected on November 29, 2007. Sontek Current Surveyor software was used to collect the data, interface with the instrument, and calibrate the compass/pitch/roll sensors. HYPACK was used to determine the locations for ADP data collection, and provided a steering display for the captain. The vessel was anchored from the stern when it was within 2 meters of the designated profiling location, and multiple profiles were collected during each occupation. Each of 12 locations was occupied 3 times throughout the day to record current data during different parts of the tidal cycle. The ADP was configured to average flow data over two minute intervals and to record the averaged values as a single profile. Profiles consisted of 0.8 ft cells.

4.9 ADP Data Processing

Raw ADP data were exported as a series of ASCII text files containing flow, navigation and quality information for each beam. Data were combined using proprietary software designed for this instrument. One 2-minute profile was selected for each occupation, based on the reported standard deviation of flow measurements and the number of acceptable cells. Submerged aquatic vegetation (SAV) caused considerable interference in multiple locations, especially Station 11, which had zero acceptable cells in each of the three occupations. For each measurement location, the number of cell layers from which velocity data was extracted was determined by the smallest depth measured from the three beams rather than the average depth (of the three beams). The positions of measurement points were assigned using the average of the start and end geographical coordinates for a sample period. ADP cell depths and flow directions were converted to negative values to display properly in data plots created using Surfer. Contour and vector plots depicting average flow velocity and direction were prepared for each of the three tide stage periods. We also prepared plots depicting bottom cell (sediment-water interface) flows and vectors to address typical capping project data requirements. Processed ADP data has been provided for further evaluation in MS Excel format, with vectors/speeds in GeoTiff format, and can be found in the ADP Data folder of the Data DVD.

5.0 RESULTS

5.1 Bathymetric Results

The bathymetric survey area extended from the northern shore of Mattawoman Creek to between 130 and 180 feet from the shoreline. Figure 2A shows the NAVD88 elevations of the creek bottom using a 1.0 ft contour interval overlaid on a georeferenced orthophoto. The maximum, mean, and minimum elevations of the survey area were –3.4, -26.1 ft and -12.9 ft, respectively. Figure 2B shows a 10x vertically exaggerated surface map of the creek bottom. The navigation channel is clearly shown, as is the shallow shelf near the northern shoreline. Approximately co-located soundings collected on perpendicular transects were statistically compared to evaluate sounding accuracy. The 95th percentile elevation accuracy was calculated as 0.20 feet after examining 75 collocated soundings. This value is well below the minimum tolerances for hydrographic surveys specified by the U.S. Army Corps of Engineers for this type of work (US ACOE, EM1110-2-1003, 2002. Ch. 3). The largest sources of errors for this conservative analysis were likely roll and pitch of the small survey vessel, and wakes from passing vessels.

5.2 Magnetometer Results

Twenty digitized magnetic anomalies are described on Table 1 and shown on Figures 3 and 5. It appears that the anomalies (likely ferrous debris like that observed littering the shoreline) extend 120 feet into the creek. A large (~130 gamma) magnetic anomaly was observed in the eastern portion of the survey area, approximately 100 ft from the shoreline, in 20 ft of water. The surficially exposed portion of this object is angular, and measures 25 ft by 8 ft, with a possible height above the creek floor of 1 foot. The object is best co-located with Contact #9 on Table 1, and is likely also associated with magnetic Contacts 7, 8, 10 and 13.

5.3 Side Scan Sonar Results

Side scan sonar results are presented as mosaics of gray shaded information. Gray shades correspond to the strength of the returning signal and is used to infer bottom type (sediment texture) and to identify underwater structures or debris. A key to sonar shading is provided below.

Key to Side-scan sonar Image Shading

Sonar shadow------------ Weak Signal Return------------------------Strong Signal Return

In general, weak signal returns correspond to smooth seabed substrates (e.g., fine sediments with little micro-topography), soft materials that absorb the signal, or seabed sloping away from the signal source (towfish). These features appear lighter gray in sonar imagery. Strong signal returns correspond to rough seabed substrates (e.g., gravel, cobble), highly reflective materials, or to a seabed sloping towards the signal source. These features appear as dark gray to black in the sonar imagery. Features that rise above the seabed (e.g., boulders) reflect more of the sonar energy than the surrounding substrate resulting in strong signal returns due to decreased angle of incidence. These features often prevent insonification of the area opposite the signal source, resulting in a sonar “shadow” (white imagery). The length of these shadows can be used to calculate the approximate height of the elevated features.

Figure 4 shows the final side scan sonar mosaic, with a resolution of 5 cm. At this scale, most of the fine detail is lost in this figure, but the shelf of hard material extending from the shoreline is clearly visible, as is the soft sediments in the navigation channel. If examined closely, debris near the toe of the slope is visible. Full resolution mosaics are to be found on the accompanying DVD, in the Side Scan Sonar section. Figure 5 is the side scan sonar mosaic with magnetic anomaly targets overlaid, and an inset showing the angular object described in section 5.2. Figure 6 shows the side scan sonar mosaic with colored bathymetric contour data overlaid to display the correlation between the toe of the slope and the debris seen in the mosaic. Figure 7 depicts screen captures of the major side scan sonar targets. Target #1 appears as an angular object collocated with magnetic anomaly #9. The object is partially buried in sediment, making exact identification difficult without groundtruthing, such as underwater video or sediment probing. Target #2, was imaged, as the survey vessel entered an area characterized by a wall of submerged aquatic vegetation. The vegetation completely obscures the sonar signal, and formed the east and west boundaries of the survey area. If side scan coverage is required in this area, operations should be performed in the early spring, before the vegetation reaches the surface. Targets #3-6, show assorted debris, including a number of objects (Target #5) at the toe of the slope from the Navy facility shoreline to the navigation channel. Approximate measurements of the objects can be found in the second column. It is probable that some of the linear objects are submerged tree trunks limbs lying on the bottom.

5.4 ADP Results

Plots of current velocities and vectors were prepared for each occupation of the 11 ADP stations. The upper limit of the vertical distribution of ADP cells was determined by the transducer mounting depth and the instrument's "blanking" zone. The instrument was mounted with its top side 0 ft beneath the water surface (BWS). The transducer faces are mounted 0.8 ft below the top of the instrument, 0.8 feet BWS. The instrument will not record data within 1.3 ft of the transducer faces (blanking distance). Based on these offsets, cell depth intervals ranged from a minimum of 2.1 to 2.2 ft BWS to a maximum of 26.8 feet BWS. All current velocities are presented in units of centimeters per second (cm/s). One cm/s equals 0.0328 feet/second. The theoretical maximum resolution of the SonTek 1.5MHz ADP is .1 cm/s, with an accuracy of 1% of the measured velocity ± .5 cm/s. The average standard deviation of the Mattawoman Creek data is 5cm/s.

Figures 8 and 9 show flow velocities and vectors for the average and bottom-most cell, respectively. Several pronounced flow patterns are evident in the water column, and these flow patterns are primarily associated with the ebb and flow of the tide. When the tide is rising, the average and bottom water movement is east in direction, with faster flows generally observed farther from shore. When the tide is falling, the average and bottom water movement direction is south-southwest, with faster average and bottom flows observed farther from shore.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The geophysical survey successfully documented a variety of features, including the tow of the slope from the Navy Facility shoreline to the navigation channel, a shallow shelf that extends 40-60 feet from shore, magnetic anomalies both nearshore and offshore, debris at the toe of the slope and collocated with magnetic anomalies, and water velocity data showing strong currents in the navigation channel during the outgoing tide. CR recommends that an additional survey be conducted in early spring to obtain survey coverage in areas where the dense submerged aquatic vegetation was encountered during the November survey. This survey could also include the use of an underwater video camera and DVR recorder to identify debris identified in the side scan sonar survey. Additional ADP stations to obtain additional flow measurements could also be occupied, especially in the shallow waters near the shoreline.

7.0 LIMITATIONS

1. Acoustic methods of remote sensing in aquatic environments are influenced by the chemical and physical characteristics of the water body and underlying sediment. Water column characteristics that introduce uncertainty include: biological interference (e.g. submerged aquatic vegetation or debris in the water column); conductivity and temperature as they affect sound velocity; and weather and other surface conditions as they effect navigation. Sediment and bottom characteristics which introduce uncertainty include supersaturated flocculent sediments; steep slopes which may interfere with bottom digitizing due to sonar beam-width and/or interference by side-lobes; and rooted vegetation. The accuracy of ADP data is strongly dependent upon the duration of profile acquisition, with longer occupations resulting in increased accuracy. CR Environmental, Inc. (CR) has made all technically feasible attempts to minimize the above uncertainties as described in the report.

2. The observations described in this report were made under the conditions stated therein. The conclusions presented in the report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of services or the time and budgetary constraints imposed by the Client.

3. The conclusions and recommendations contained in this report are based in part upon the data obtained using acoustic remote sensing observations obtained along survey transects spaced approximately 10 ft apart and point flow measurements spaced approximately 300 feet apart. Information presented by this report for areas between the survey transects (i.e., depth contours) is based on mathematical interpolation. Some parameters of interest (e.g., flow and velocity) are temporally variable.

Readers are cautioned to consider the short duration of this survey event relative to the time scales of the environment (tides, seasons, etc.)

TABLE 1

MAGNETIC ANOMALIES DIGITIZED DURING DATA REVIEW
AREA A: MATTAWOMAN CREEK, INDIAN HEAD, MARYLAND

ID	EASTING	NORTHING	MAGNITUDE [1]	SHAPE [2]	NOTES
1	382953	99741	40	DP	
2	383042	99750	20	MP+	
3	383137	99783	7	DP	
4	383035	99754	13	DP	
5	382946	99747	8	MP-	
6	383009	99760	12	MP+	
7	383120	99784	24	DP	
8	383118	99787	75	DP	
9	383113	99787	130	DP	
10	383111	99791	40	DP	
11	382925	99768	30	MP-	
12	382890	99772	140	MP+	
13	383112	99794	25	DP	
14	383148	99821	255	MP-	Noisy, low confidence
15	383158	99830	150	MP-	Noisy, low confidence
16	382923	99774	250	MP+	
17	382927	99775	210	MP+	
18	383109	99806	80	NOISY	Multiple +/- signals
19	383019	99790	48	DP	
20	383111	99808	227	DP	

Notes:

1. Magnitude approximate based on comparison with preceeding background data.
2. Shapes include dipolar (sine-wave response) and monopolar. Monopolar signals were further classified as positive or negative based on the degree of the response compared to preceeding background data.
3. Coordinates are MD State Plane, NAD83, Metric.

FIGURE 1

LOCUS MAP
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD

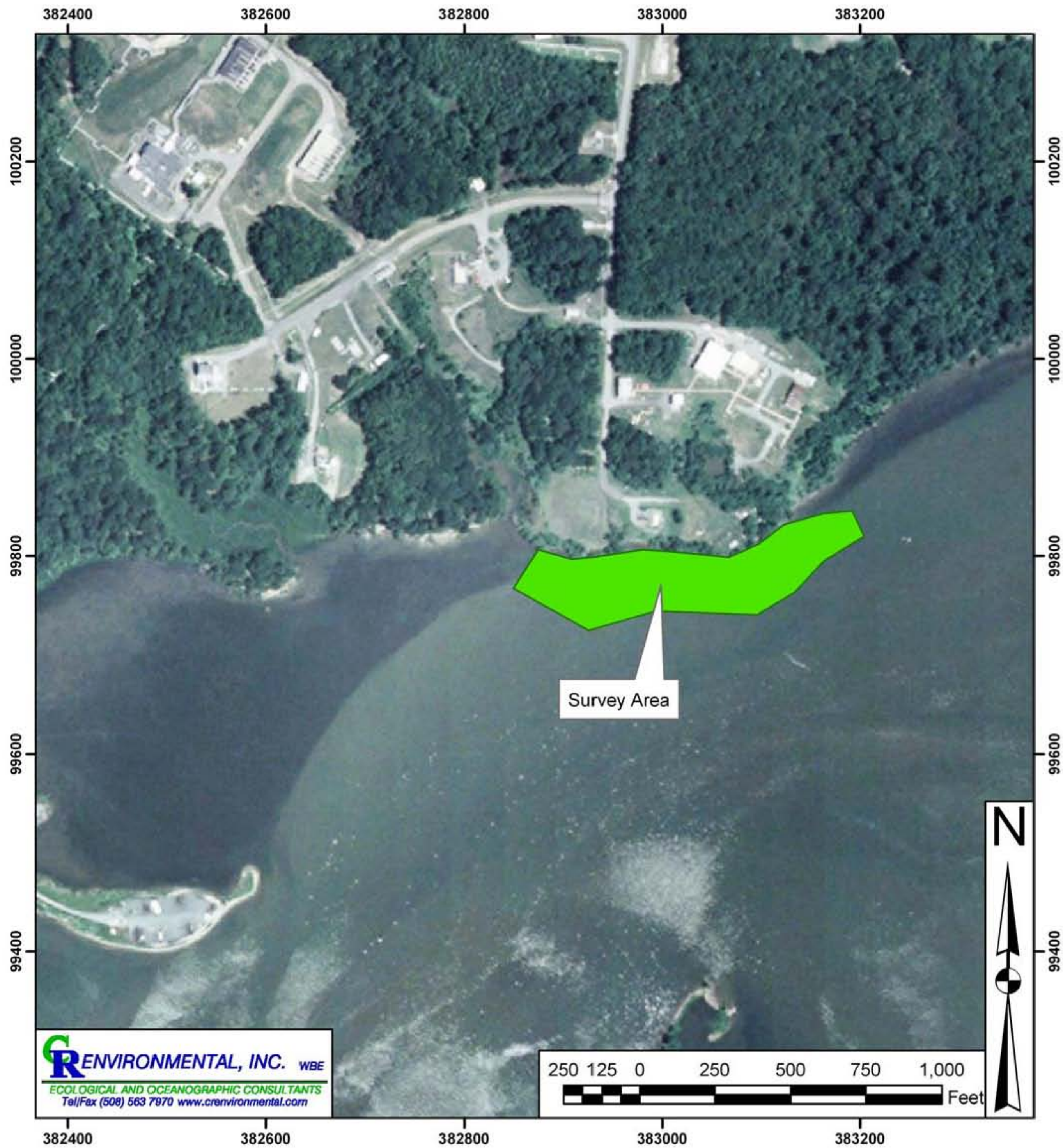
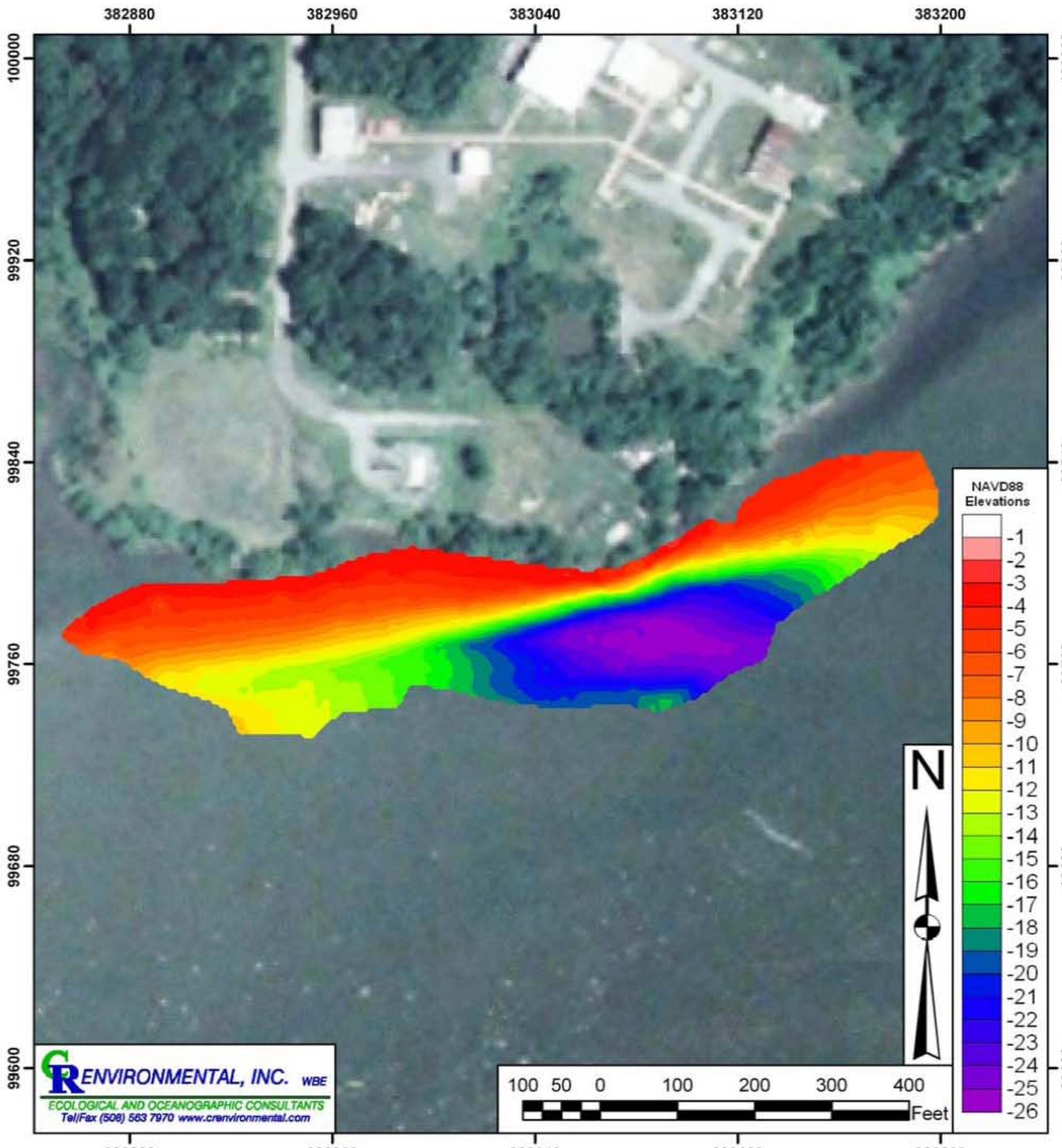


FIGURE 2A

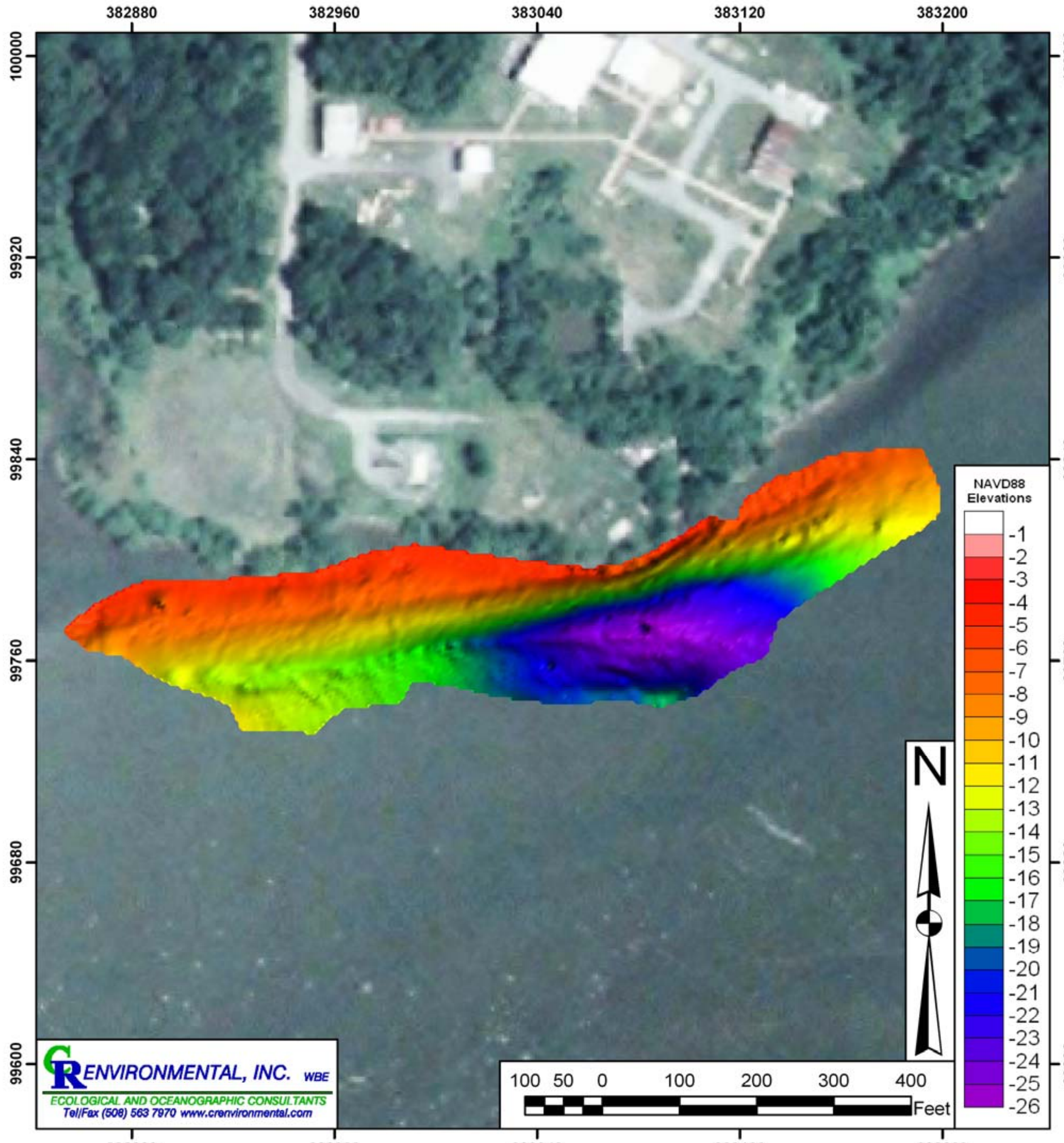
BATHYMETRIC CONTOUR MAP
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD
(1.0 Ft Contour Interval)



Notes: Coordinates in Maryland State Plane, NAD83, Meters. Depths are in U.S. Survey Feet, NAVD88.

FIGURE 2B

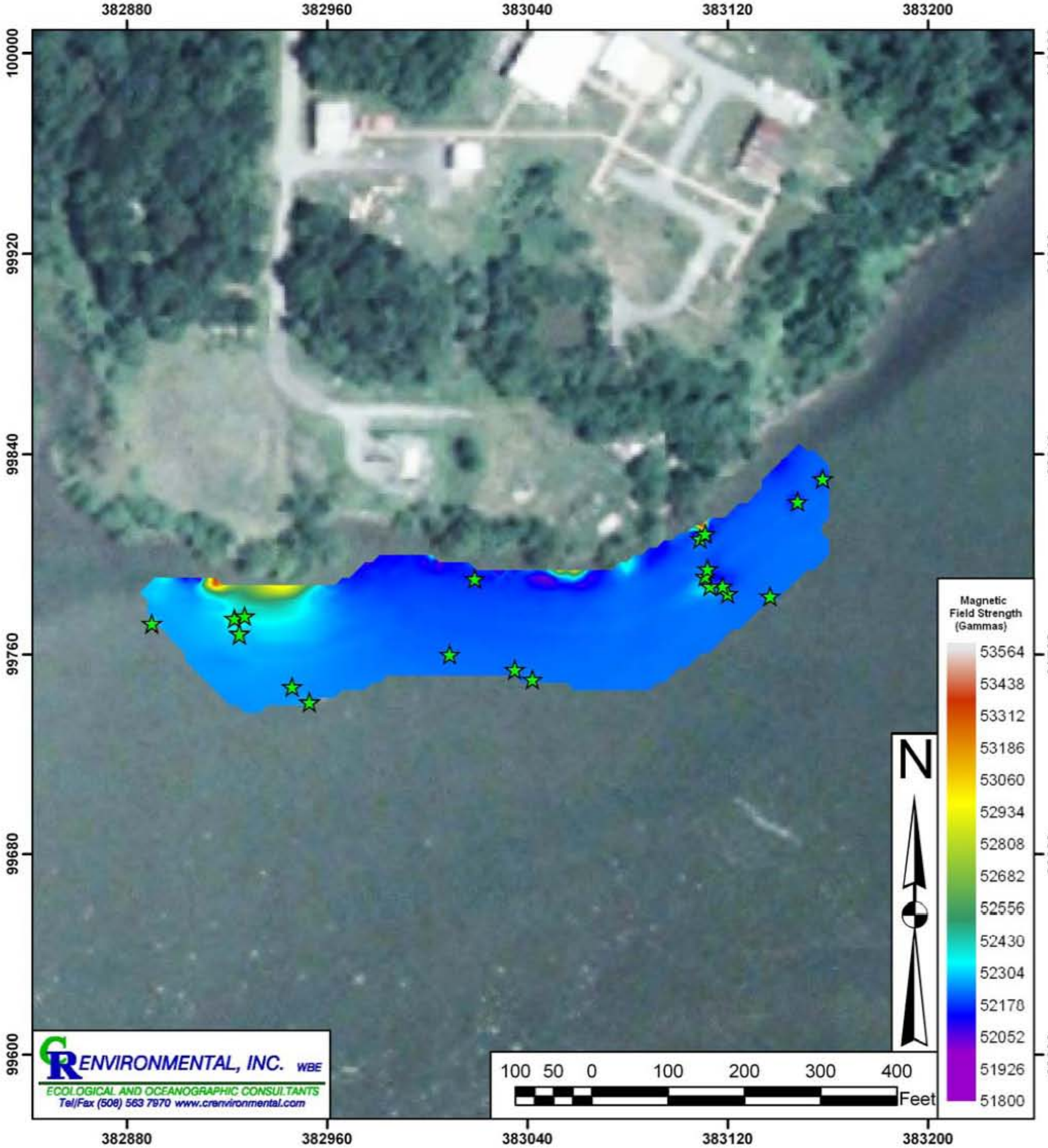
BATHYMETRIC SURFACE MAP
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD
(10X Vertical Exaggeration)



Notes: Coordinates in Maryland State Plane, NAD83, Meters. Depths are in U.S. Survey Feet, NAVD88.

FIGURE 3

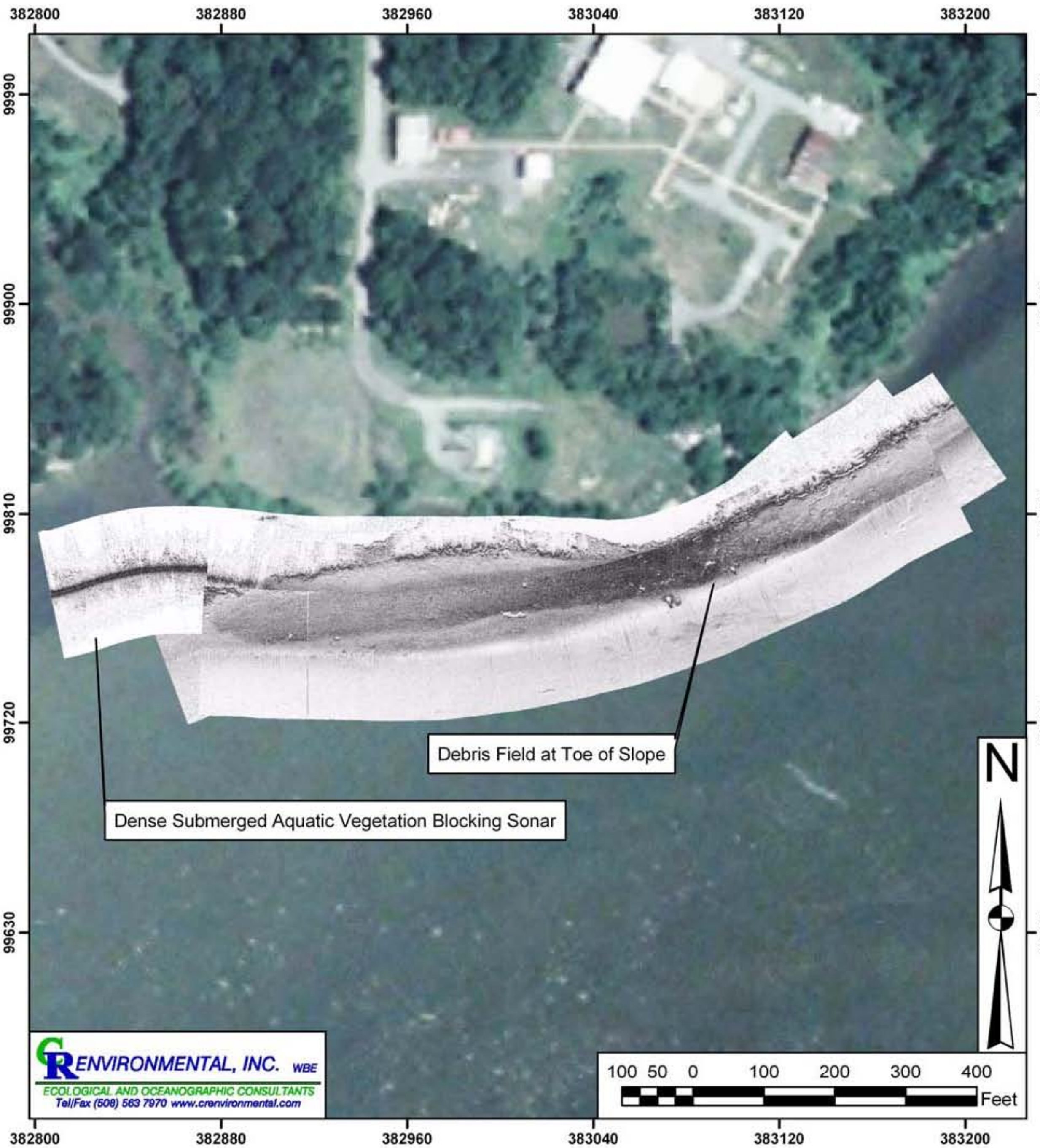
MAGNETIC CONTOUR MAP
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD



Notes: Coordinates in Maryland State Plane, NAD83, Meters. 1 Gamma=1nanoTesla

FIGURE 4

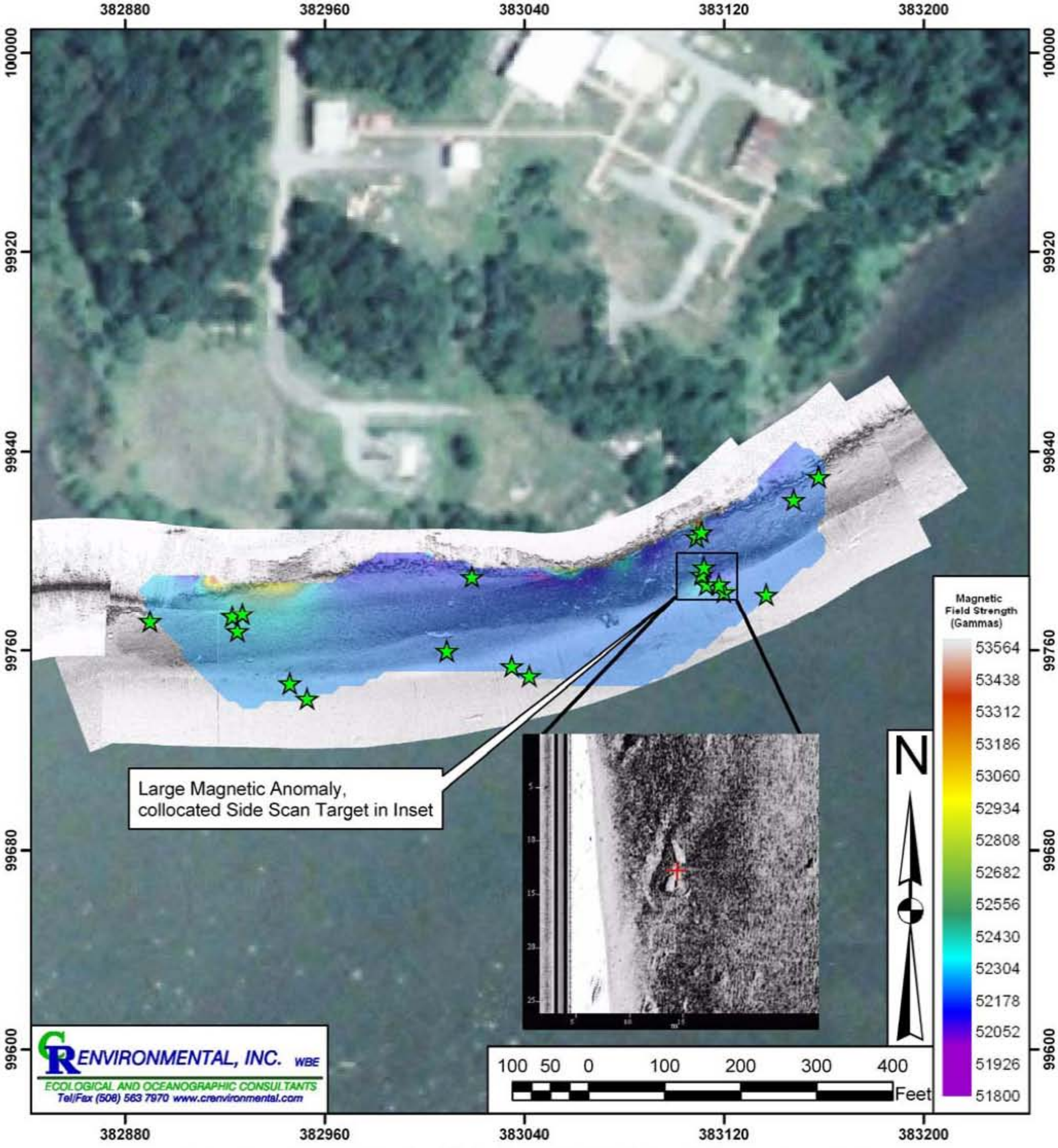
SIDE SCAN SONAR MOSAIC
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD



Notes: Coordinates in Maryland State Plane, NAD83, Meters.

FIGURE 5

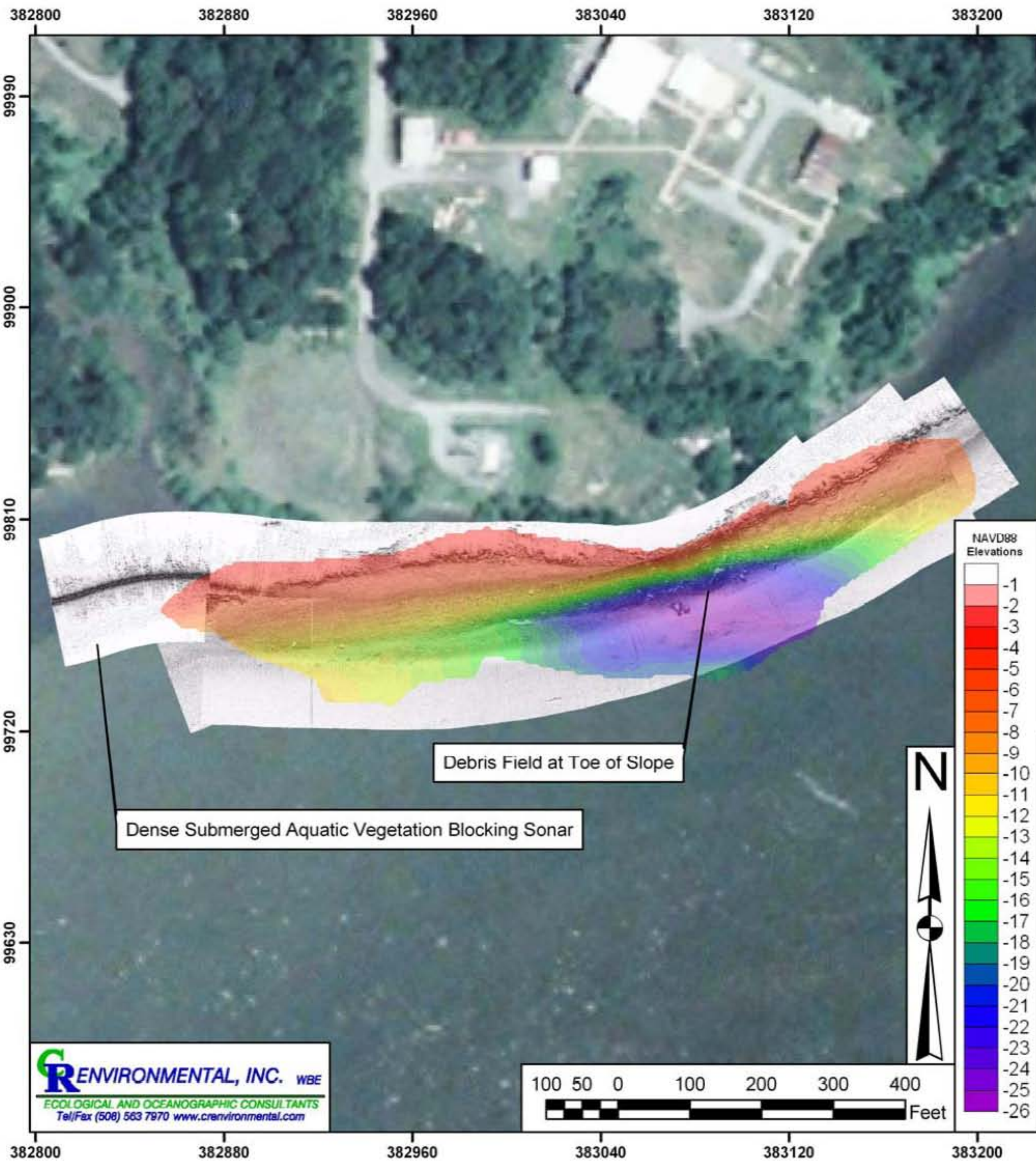
MAGNETIC CONTOUR MAP
OVERLAID ON SIDE SCAN SONAR MOSAIC
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD



Notes: Coordinates in Maryland State Plane, NAD83, Meters. 1 Gamma=1nanoTesla

FIGURE 6

**BATHYMETRIC CONTOUR MAP
OVERLAID ON SIDE SCAN SONAR MOSAIC
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD**



Notes: Coordinates in Maryland State Plane, NAD83, Meters. Depths are in U.S. Survey Feet, NAVD88.

FIGURE 7

SIDE SCAN SONAR TARGETS # 1-6
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD

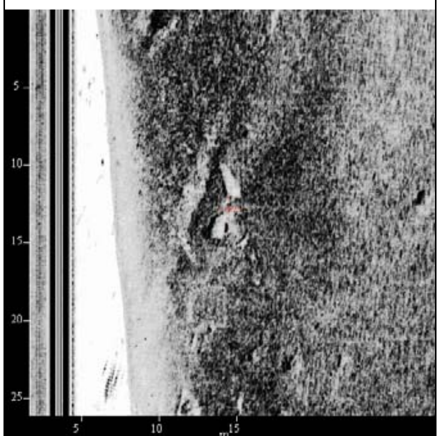
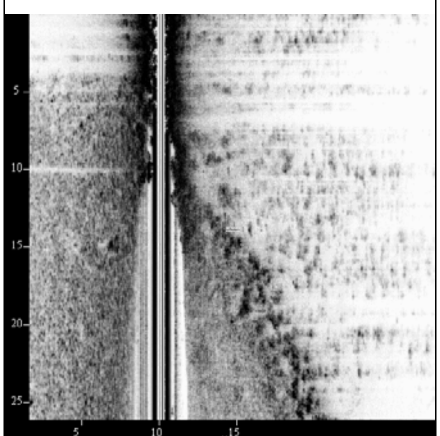
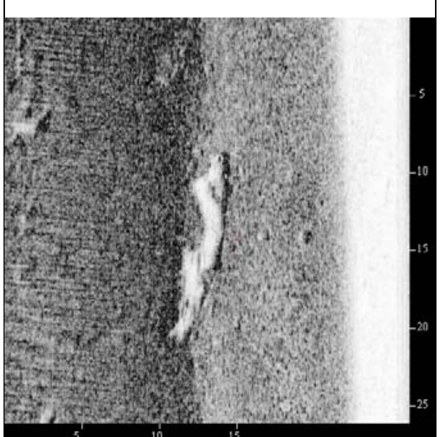
Target Image	Target Info	Target Measurements
	**Target #1: Angular Debris – Likely ferrous** • Sonar Time at Target: 11/28/2007 14:25:16 • Click Position (Lat): 38.5654867 • Click Position (Lon): -77.1937253 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 383,116.72 • Click Position (Y): 99,790.47 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-1.xtf • Ping Number: 9484 • Range to Target: 10.30 Meters • Fish Height: 3.87 Meters • Event Number: 0 • Line Name: Line-1 • Area / Block:	**Dimensions** Target Description: Target Height = 0.35 Meters Target Length: 8.06 Meters Target Shadow: 1.69 Meters Target Width: 2.51 Meters
	**Target #2: Wall of Vegetation** • Sonar Time at Target: 11/28/2007 14:50:30 • Click Position (Lat): 38.5652713 • Click Position (Lon): -77.1968310 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 382,846.02 • Click Position (Y): 99,767.13 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-4.xtf • Ping Number: 8448 • Range to Target: 3.79 Meters • Fish Height: 1.35 Meters • Event Number: 0 • Line Name: Line-4 • Area / Block:	**Dimensions** Target Description: Target Length: 18.57 Meters
	**Target #3: Linear Debris with shadow** • Sonar Time at Target: 11/28/2007 14:39:28 • Click Position (Lat): 38.5652587 • Click Position (Lon): -77.1949940 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 383,006.10 • Click Position (Y): 99,765.39 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-3.xtf • Ping Number: 4611 • Range to Target: 13.60 Meters • Fish Height: 4.98 Meters • Event Number: 0 • Line Name: Line-3 • Area / Block:	**Dimensions** Target Description: Target Height = 1.08 Meters Target Length: 11.14 Meters Target Shadow: 2.12 Meters Target Width: 0.57 Meters

FIGURE 7 (Continued)

SIDE SCAN SONAR TARGETS # 1-6
AREA A: MATTAWOMAN CREEK
INDIAN HEAD,MD

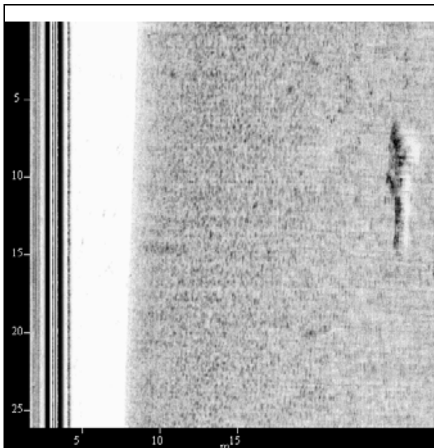
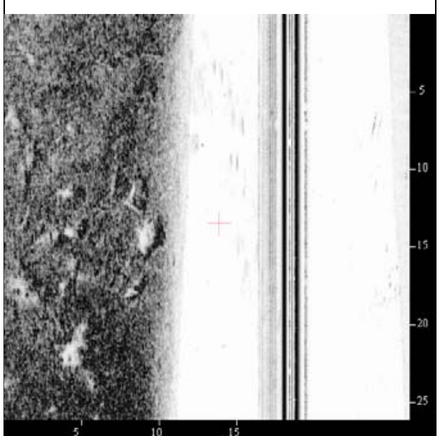
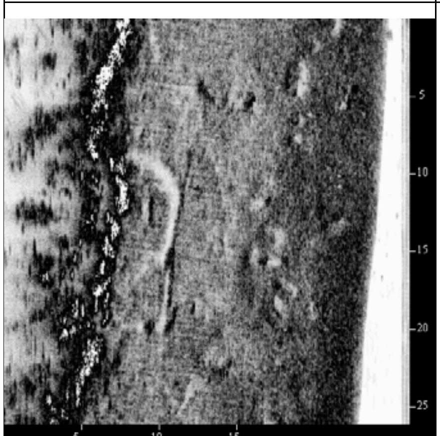
	**Target #4: Linear Debris** • Sonar Time at Target: 11/28/2007 14:39:36 • Click Position (Lat): 38.5649635 • Click Position (Lon): -77.1948318 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 383,020.16 • Click Position (Y): 99,732.60 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-3.xtf • Ping Number: 4813 • Range to Target: 10.70 Meters • Fish Height: 5.15 Meters • Event Number: 0 • Line Name: Line-3 • Area / Block:	**Dimensions** Target Description: Target Height = 0.31 Meters Target Length: 7.61 Meters Target Shadow: 1.31 Meters Target Width: 0.65 Meters
	**Target #5: Debris at toe of slope** • Sonar Time at Target: 11/28/2007 14:41:28 • Click Position (Lat): 38.5654375 • Click Position (Lon): -77.1939153 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 383,100.16 • Click Position (Y): 99,785.04 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-3.xtf • Ping Number: 7806 • Range to Target: 4.61 Meters • Fish Height: 7.05 Meters • Event Number: 0 • Line Name: Line-3 • Area / Block:	**Dimensions** Target Description: Target Height = 0.78 Meters Target Length: 3.27 Meters Target Shadow: 1.14 Meters Target Width: 0.67 Meters
	**Target #6: Linear Debris among field of Debris** • Sonar Time at Target: 11/28/2007 14:42:33 • Click Position (Lat): 38.5657235 • Click Position (Lon): -77.1934731 • Map Projection: NAD83 Maryland State Plane Zone, Meter • Click Position (X): 383,138.77 • Click Position (Y): 99,816.70 • Acoustic Source File: C:\Hypack\Projects\ch2mhill-indian_head_md\IndianHead_sss\XTF\Line-3.xtf • Ping Number: 9537 • Range to Target: 16.20 Meters • Fish Height: 3.92 Meters • Event Number: 0 • Line Name: Line-3 • Area / Block:	**Dimensions** Target Description: Target Height = 0.19 Meters Target Length: 10.40 Meters Target Shadow: 1.09 Meters Target Width: 0.55 Meters

FIGURE 8

AVERAGE WATER VELOCITY
AREA A: MATTAWOMAN CREEK
INDIAN CREEK, MD

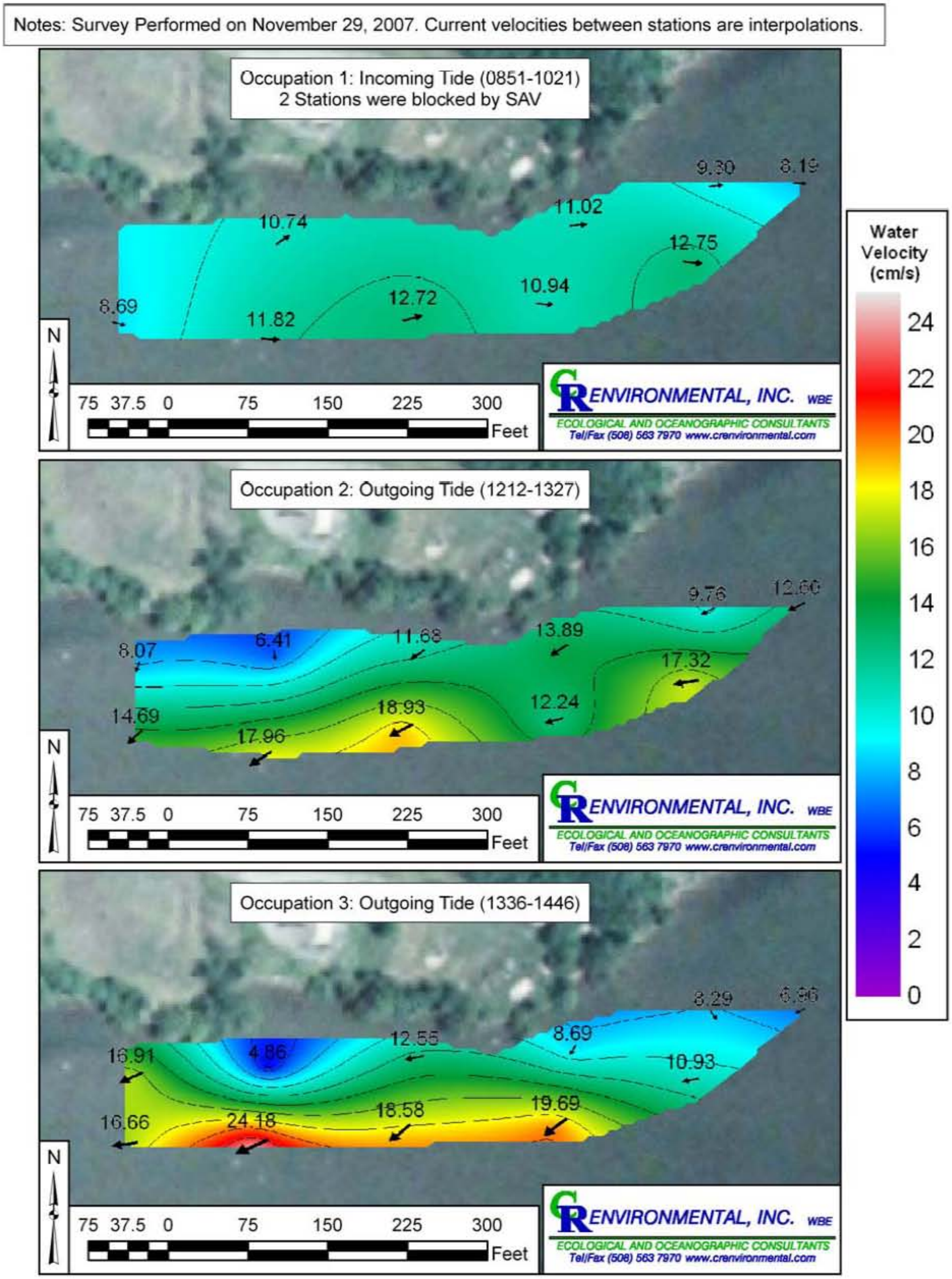
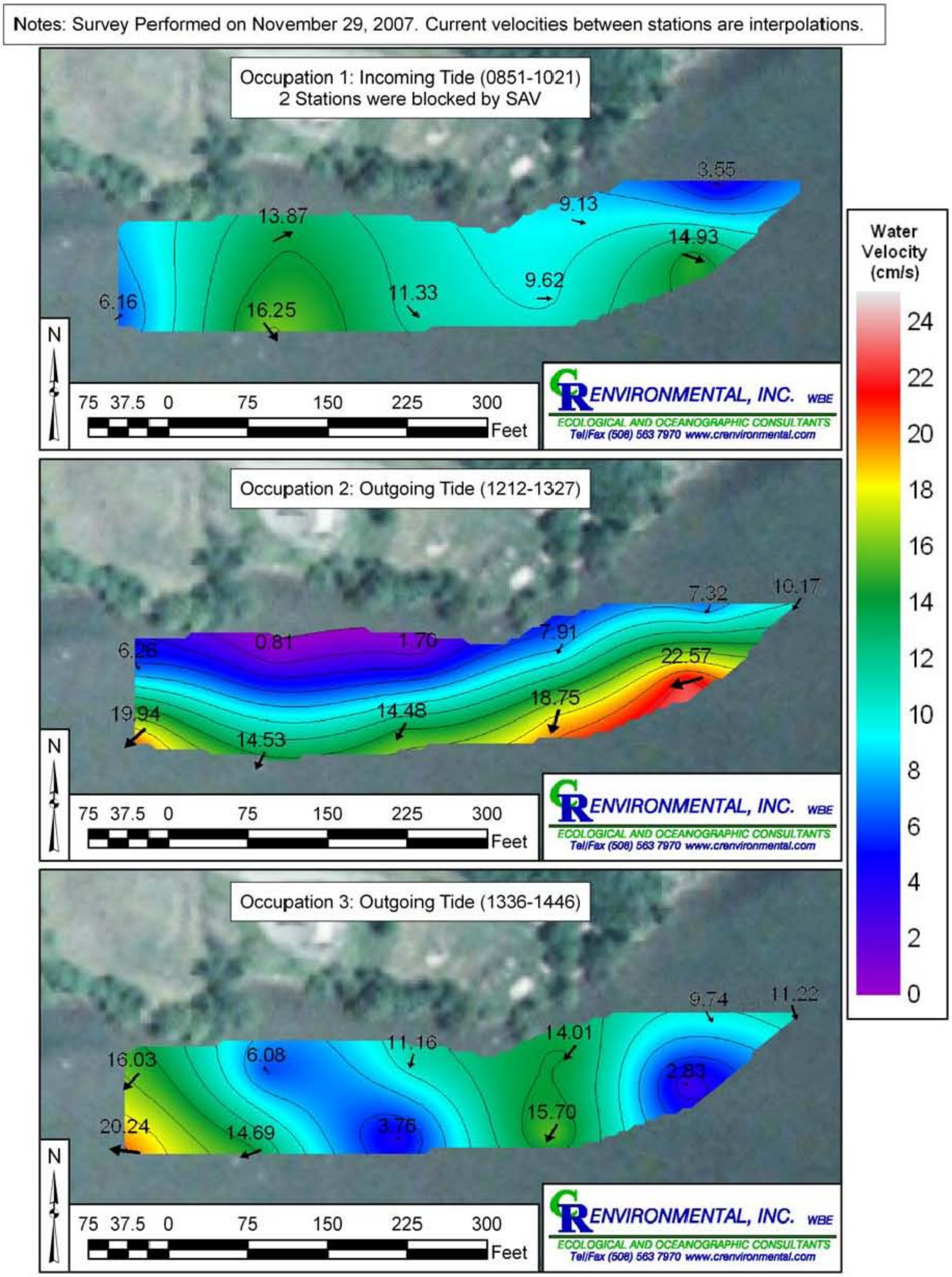


FIGURE 9

BOTTOM WATER VELOCITY
AREA A: MATTAWOMAN CREEK
INDIAN HEAD, MD



Appendix F
Area B HHRA Results

Appendix F-1
Site 11 Area B HHRA Results

MEMORANDUM

Human Health Risk Evaluation, Site 11, NDWIH, Indian Head, Maryland

PREPARED FOR:	Gunarti Coghlan/WDC Margaret Kasim/WDC
PREPARED BY:	Jennifer Matchett/WDC
COPIES:	Gene Peters/WDC
DATE:	July 12, 2005

The purpose of this Memorandum is to present the results of the human health risk assessment (HHRA) for Area B at Site 11 at Naval District Washington, Indian Head (NDWIH), Indian Head, Maryland. The results of this evaluation will be used in support of the Feasibility Study (FS) underway for Site 11.

A baseline HHRA was performed for Site 11 as part of the Remedial Investigation (RI) (CH2M HILL 2004). The risk assessment was performed on combined data from Area A and Area B. However, it is deemed that a separate HHRA evaluation for Area B is necessary for the following reasons:

- The HHRA in the RI Report was conducted for site-wide risks, combining Areas A and B, even though these areas have different historical uses and contaminant sources. Based on past uses, Site 11 comprises three different areas: Area A and the Upland Area, where landfilling occurred (combined as Area A for the purpose of this memo) and Area B, where incineration or waste burning occurred. In the RI, Site 11 was treated as one contiguous exposure area for the HHRA. In the FS, Area A will be treated as a landfill and capped. This creates fundamentally different land use and exposure scenarios for Area A compared to Area B, which will not be capped.

- The soil and groundwater datasets from Areas A and B at Site 11 are different. For example, zinc was identified as a COC in soil when the datasets for Areas A and B were combined (per the PRG memo), but the maximum detected concentration of zinc in soil from Area B alone is less than the risk-based concentration (RBC) for residential contact with soil. In other words, zinc is present at Area B at concentrations sufficiently low that exposure to zinc would not be quantified in a risk assessment solely for the Area B soils; yet when the datasets are combined, zinc is a risk driver. Recalculating the HHRA only for Area B eliminates bias from data from Area A, to which Area B receptors would not be exposed. Furthermore, because COC concentrations are lower in Area B (the preponderance of COC detections is in Area A), recalculating risks just for Area B with subsequent PRGs, would reduce the number of COCs and result in a more realistic representation of human health risks in Area B.

Site-Wide Baseline Human Health Risk Assessment (2004)

Human health risks were evaluated for exposure to surface soil, combined surface and subsurface soil, and groundwater at Site 11. The receptors evaluated in the baseline HHRA were:

- Current trespasser/ visitor (adult and adolescent) exposed to surface soil,
- Current industrial worker exposed to surface soil,
- Current/future recreational user (child and adult) exposed to surface water,
- Future resident (child, adult, and lifetime) exposed to groundwater and combined surface and subsurface soil,
- Future construction worker exposed to groundwater and combined surface and subsurface soil,
- Future industrial worker exposed to combined surface and subsurface soil, and
- Future trespasser/ visitor (adult and adolescent) exposed to combined surface and subsurface soil.

The baseline HHRA in the RI concluded that future residential use of the site may result in hazards and risks to children and adults above USEPA's target levels. Cadmium and iron in the soil and aluminum, arsenic, barium, chromium, iron, manganese, and vanadium in the groundwater were identified as the main contributors to the hazards and risks in the RI. The concentrations of all of these inorganic constituents were greater than the concentrations detected in the site-specific background groundwater and soil samples.

Risk-based preliminary remediation goals (PRGs) were calculated for groundwater and soil at Site 11 and were presented in a memorandum dated July 22, 2004. Risk-based PRGs were calculated for the constituents identified as constituents of concern (COCs) in the soil and groundwater, the individual constituents which contributed a carcinogenic risk of 10^{-6} or greater to a cumulative carcinogenic risk above 10^{-4}, or a noncarcinogenic hazard of 0.1 or above for individual target organs with a cumulative hazard of greater than one. Based on this definition, PRGs were calculated for the following COCs:

- Soil COCs: aluminum, antimony, arsenic, cadmium, chromium, copper, iron, manganese, silver, thallium, vanadium, and zinc.
- Groundwater COCs: aluminum, antimony, arsenic, barium, chromium, iron, manganese, nickel, and vanadium.

Area B Human Health Risk Assessment

The exposure assumptions and methods used in the RI HHRA were also applied to this assessment. This approach was taken since the RI HHRA has been finalized and, therefore, all stakeholders have had an opportunity to review and comment on the methodology and assumptions applied in the HHRA. The only updates that were made to the RI methodology for this assessment are listed below:

- Constituents of potential concern (COPCs) were identified based on a comparison to the most current USEPA Region III Risk-Based Concentration (RBC) table (USEPA, April 2005)

- Exposure point concentrations (EPCs) were calculated using the most current version of the USEPA's ProUCL program (Version 3.00.02).

- Dermal exposure to COPCs in soil and groundwater was calculated using the USEPA's updated guidance for dermal assessment (Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment - Final. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.USEPA/540/R/99/005. July 2004.).

- The most current toxicity values were used for the COPCs.

- The constituents of concern (COCs) were identified based on the COPCs that contributed a carcinogenic risk of 10^{-6} or greater to a cumulative carcinogenic risk above 10^{-4}, or a noncarcinogenic hazard of 0.1 or above for individual target organs with a cumulative hazard of greater than one.

- Risk-based preliminary remediation goals (PRGs) were then calculated for each COC.

The HHRA was recalculated only for Area B for the following receptor scenarios:

- Current industrial worker exposed to surface soil,

- Future industrial worker exposed to combined surface and subsurface soil,

- Future resident (child, adult, and lifetime) exposed to groundwater and combined surface and subsurface soil, and

- Future construction worker exposed to groundwater and combined surface and subsurface soil.

Data Analysis

A subset of the dataset used in the RI HHRA was used to update the HHRA for Area B. For soil, the dataset consists of data from station IDs: IS11SO43, IS11SO44, IS11SO45, IS11SO46, IS11SO47, IS11SO48, IS11SO49, IS11SO50, IS11SO51, IS11SO52, and IS11SO53. For groundwater, the dataset consists of data from monitoring wells IS11MW06, IS11MW07, and IS11MW08.

Selection of COPCs

COPCs were identified based on a comparison of the data to the most current USEPA Region III RBCs (USEPA, April 2005). Similar to the RI, RBCs based on noncarcinogenic endpoints were adjusted by a factor of ten, so they were based on a HI of 0.1, and RBCs based on carcinogenic endpoints were based on an incremental lifetime cancer risk of one in one million.

Based on a comparison of the surface soil data to the residential soil screening levels, the following COPCs were identified in Area B: two SVOCs (benzo[a]pyrene and dibenz[a,h]anthracene) and ten inorganics (aluminum, antimony, arsenic, cadmium, chromium, copper, iron, manganese, thallium, and vanadium).

Based on a comparison of the combined surface and subsurface soil data to the residential soil screening levels, the following COPCs were identified in the Area B: four SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and dibenz[a,h]anthracene) and ten inorganics (aluminum, antimony, arsenic, cadmium, chromium, copper, iron, manganese, thallium, and vanadium).

Based on a comparison of the groundwater data to the tap water RBCs, the following COPCs were identified in Area B: two VOCs (benzene and bromomethane) and four inorganics (antimony, arsenic, iron, and manganese). The results for total rather than filtered inorganics were used in this assessment because the filtered and total results from the same wells were similar for iron and manganese (USEPA, 1992). Furthermore, the maximum detected concentration was used as the EPC for the updated HHRA.

HHRA Summary

The results of the updated risk characterization for Area B soil and groundwater are presented below. Total risks are summarized by receptor following the medium-specific discussions. Table 1 summarizes the risks and hazards for each exposure scenario and for the COPCs selected for soil. Table 2 summarizes the risks and hazards for each exposure scenario and for the COPCs selected for groundwater. The HHRA uncertainties considered herein are consistent with those described in the RI with no changes.

Area B Soil

Three receptor groups were evaluated for contact with current soil and the risk evaluations were all either below or within EPA's acceptable risk ranges (10^{-4} to 10^{-6} for carcinogens and HI at or above 1 for non-carcinogens) for Superfund sites with the exception of iron. For the future residents and industrial workers, the risk assessment conservatively assumes that these receptors be in contact with the current subsurface soil at the surface (i.e., as surface soil) in the future.

The COPCs identified for Area B soil, which also became COCs were aluminum, antimony, arsenic, cadmium, chromium, copper, manganese, thallium, and vanadium. The SVOCs identified as COPCs were not identified as COCs because all the SVOCs were only evaluated as potential carcinogens and the estimated incremental lifetime cancer risk for a future resident was within the USEPA target range (1E-04 to 1E-06) as reported on Table 1.

The future child resident exposed to iron (HQ of 1.6) in combined surface and subsurface soil could experience adverse health effects based on the RME evaluations. However, the toxicity value used in the risk assessment for iron is based on toxicity to adult males (USEPA, 1999). Therefore it is useful to compare the estimated risks for the future child with nutritional requirements for iron. The child's estimated daily intake of iron (0.44 mg/kg-day) from soil is consistent with the recommended daily allowance (RDA) range for children ages 6 months to 10 years (0.36 – 1.11 mg/kg-day) (USEPA, 1999). Furthermore, the child's daily intake of iron (0.44 mg/kg-day) is less than the tolerable upper intake level

(UL[1]) set by the National Academy of Sciences for children ages 1 – 8 years (1.8 mg/kg-day to 3.4 mg/kg-day) (NAS, 2004). Since the estimated intake was within values considered nutritional, and less than values considered as "tolerable upper limits" for children when combined with dietary intake, it is unlikely that future child residents exposed to iron in soil at Area B would experience adverse health effects. For this reason, iron was not identified as a COC.

Area B Groundwater

The COPCs, which became COCs identified for Area B groundwater, were antimony, arsenic, and manganese. Althoughtwo VOCs were identified as COPCs, they were not carried forward as COCs because they did not contribute significantly to the calculated risks for the future lifetime resident (exposure to benzene resulted in a cancer risk = 1×10^{-6}) or the future child resident (benzene HQ = 0.02 and bromomethane HQ = 0.09).

As shown on Table 2, the future construction worker that has dermal contact with groundwater at Area B would not be expected to experience adverse health effects. Future residential receptors exposed to arsenic, iron, and manganese in shallow groundwater used as a potable source could experience adverse health effects. However, the child's daily intake of iron from groundwater (0.45 mg/kg-day) associated with environmental exposure is consistent with the RDA range for children ages 6 months to 10 years (0.36 – 1.11 mg/kg-day) (USEPA, 1999) and is less than the UL (1.8 mg/kg-day to 3.4 mg/kg-day) (NAS, 2004). Since the incremental environmental exposure in addition to dietary intake is below toxic thresholds for children, exposure to iron in groundwater by future child residents should not be considered a health concern. For this reason, iron was eliminated from the COC list.

Table 3 presents the comparison of COCs based on the Baseline HHRA and Area B HHRA. As shown, the COCs for both soil and groundwater at Area B are fewer than those determined in the Baseline HHRA.

PRG Calculations

The COCs identified in soil and groundwater at Area B were identified based on their potential noncarcinogenic effects. Although arsenic is also assessed as a carcinogenic substance in the HHRA, the future resident cancer risks from ingestion of groundwater were within the USEPA target range. Therefore the Area B PRGs were calculated based on the following equation for noncarcinogenic effects:

$$\text{PRG} = \left(\frac{\text{EPC from HHRA} \times \text{Target HI}}{\text{HQ from HHRA}} \right)$$

Where: EPC = exposure point concentration used in the risk calculation

HQ = calculated hazard quotient from the risk calculation

Target HI = Target hazard index based on target organ

Based on the Area B HHRA, PRGs were calculated for COCs, which consists of nine constituents (aluminum, antimony, arsenic, cadmium, chromium, copper, manganese, thallium, and vanadium) in soil and three constituents (antimony, arsenic, and manganese)

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[1] UL = The maximum level of daily nutrient intake that is likely to pose no risk of adverse effects.

in groundwater. The updated risk-based PRG calculations for combined surface and subsurface soil and for groundwater are shown in Table 4. Table 4 also shows the comparison between the PRGs calculated based on the baseline HHRA and PRGs calculated based on the Area B HHRA.

Table 4 presents risk management information related to the PRGs, including maximum detected concentration and exposure point concentrations at Area B, background concentrations, risk-based PRGs, and Federal Maximum Contaminant Levels (MCLs) for groundwater (USEPA, 2004).

As shown on Table 4, the maximum detected concentration and/or the exposure point concentrations for aluminum, antimony, arsenic, cadmium, chromium, copper, and manganese in soil are less than the calculated risk-based PRGs. The detected concentrations of thallium and vanadium in soil are consistent with or less than background conditions. In summary, there are no presumptively unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil.

In groundwater at Area B, antimony and arsenic were detected at concentrations less than the risk-based PRG and the MCLs for groundwater (USEPA, 2004). The site concentrations of arsenic, iron, and manganese are either less than or consistent with background conditions.

Based on the comparisons shown in Table 4, remedial actions are not necessarily required for either soil or groundwater at Area B.

References

CH2M HILL, 2004. *Final Remedial Investigation Report for Sites 11, 13, 17, 21, and 25.*

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National Academy of Sciences, 2004. *Dietary Reference Intakes (DRIs): Tolerable Upper Intake Levels (ULs), Elements.*

Tetra Tech NUS. 2002. *Background Soil Investigation Report for Indian Head and Stump Neck Annex, Naval Surface Warfare Center, Indian Head Maryland.* October.

USEPA, August 1992. Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Assessment of Risk. August 10, 1992.

USEPA, January 1999. Risk Assessment Issue Paper for Derivation of a Provisional RfD for Iron (CASRN 7439-89-6). National Center for Environmental Assessment. January 5, 1999.

USEPA, July 2004. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final.* EPA/540/R/99/005. OSWER 9285.7-02EP. July.

USEPA, 2004. *2004 Edition of the Drinking Water Standards and Health Advisories.* EPA 822-R-04-005. Office of Water. Washington, DC. Winter 2004.

USEPA, April 2005. Risk-Based Concentration Table. Region III. April 7, 2005.

Table 1 – Risk Characterization Summary for Contact with Subsurface Soil at Area B

Receptor	Exposure Medium and Pathway	HHRA Summary	Comments
Trespasser/Visitor Adult (Current)	Surface soil at Site 14 - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME cancer risk (2×10^{-6}) within EPA target range. RME HI (0.1) is less than the EPA target HI.
Trespasser/Visitor Adolescent (Current)	Surface soil at Site 14 - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME cancer risk (1×10^{-6}) within EPA target range. RME HI (0.2) is less than the EPA target HI.
Industrial Worker (Current)	Surface soil at Site 14 - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME cancer risk (1×10^{-5}) within EPA target range. RME HI (0.8) is less than the EPA target HI.
Construction Worker (Future)	Combined surface and subsurface soil at Site 11, Area B present at the surface - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME cancer risk (1×10^{-6}) within EPA target range. RME HI (0.8) is less than the EPA target HI.
Industrial Workers (Future)	Combined surface and subsurface soil at Site 11, Area B present at the surface - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME cancer risk (1×10^{-5}) within EPA target range. RME HI (0.5) is less than the EPA target HI.
Adult Resident (Future)	Combined surface and subsurface soil at Site 11, Area B present at the surface - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME HI (0.6) is less than the EPA target HI.
Child Resident (Future)	Combined surface and subsurface soil at Site 11, Area B present at the surface - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected.	RME HI (6) above EPA's target. Iron (HQ = 1.5) is the only COPC with HQ >1. CTE HI (1) is equal to the EPA's target.

Receptor	Exposure Medium and Pathway	HHRA Summary	Comments
Lifetime Resident (Future)	Combined surface and subsurface soil at Site 11, Area B present at the surface - Incidental ingestion, dermal contact, and inhalation	No adverse health effects expected	RME cancer risk (5×10^{-5}) within EPA target range. CTE cancer risk (1×10^{-5}) is within the EPA's target range.

Table 2 – Risk Characterization Summary for Contact with Groundwater at Area B

Receptor	Exposure Medium and Pathway	HHRA Summary	Comments
Construction Worker (Future)	Shallow groundwater at Site 11, Area B present at the surface - Dermal contact and inhalation of volatiles	No adverse health effects expected	RME cancer risk (2×10^{-8}) less than EPA target range. RME HI (1) equal to the EPA target HI.
Adult Resident (Future)	Shallow groundwater at Site 11, Area B present at the surface – Daily ingestion, dermal contact and inhalation of volatiles while showering	Adverse health effects possible due to ingestion of iron and manganese.	RME HI (9) above EPA's target. Iron (HQ = 4.1) and manganese (HQ = 4.7) are COPCs with HQ >1. CTE HI (3) above EPA's target. Iron (HQ = 1.7) and manganese (HQ = 1.6) are COPCs with HQ >1.
Child Resident (Future)	Shallow groundwater at Site 11, Area B present at the surface – Daily ingestion and dermal contact	Adverse health effects possible due to ingestion of iron and manganese.	RME HI (22) above EPA's target. Iron (HQ = 9.6) and manganese (HQ = 11) are the only COPCs with HQ >1. CTE HI (11) above EPA's target. Iron (HQ = 5.6) and manganese (HQ = 5.3) are the only COPCs with HQ >1.
Lifetime Resident (Future)	Shallow groundwater at Site 11, Area B present at the surface – Daily ingestion, dermal contact and inhalation of volatiles while showering	No adverse health effects expected	RME cancer risk (7×10^{-5}) is within EPA target range. Ingestion of arsenic (6.5×10^{-5}) drives this potential risk. CTE cancer risk (1×10^{-5}) is within the EPA's target range.

Table 3. Summary of COCs, Data, and calculated HIs from the Baseline HHRA and the Area B HHRA.

Constituent	Data						Calculated HI for Future Child Resident				COCs			
	Background		Site 11 EPC		Area B EPC		Site 11		Area B		Site 11		Area B	
	Soil	GW	Soil	GW	Soil	GW	Soil	GW	Soil	GW	Soil	GW	Soil	GW
Aluminum	11,500	73,400	10,721	31,400	10,850	NA	0.14	2.0	0.14	NA	Yes	Yes	Yes	No
Antimony	1.8	ND	7.6	4.7	7.3	2.9	0.27	0.76	0.28	0.48	Yes	Yes	Yes	Yes
Arsenic	18	19	15	8.2	15	2.9	0.68	1.8	0.71	0.62	Yes	Yes	Yes	Yes
Barium	101	688	NA	1,680	NA	NA	NA	1.6	NA	NA	No	Yes	No	No
Cadmium	0.18	9.8	145	NA	11	NA	2.0	NA	0.15	NA	Yes	No	Yes	No
Chromium	46.5	191	41	60	59	NA	0.30	1.4	0.53	NA	Yes	Yes	Yes	No
Copper	26	166	1,669	NA	467	NA	0.55	NA	0.15	NA	Yes	No	Yes	No
Manganese	266	2,290	486	2,637	392	3,020	0.50	8.5	0.43	11	Yes	Yes	Yes	Yes
Nickel	18	166	43	110	NA	NA	0.04	0.37	NA	NA	Yes	Yes	No	No
Silver	2.2	ND	29	NA	NA	NA	0.11	NA	NA	NA	Yes	No	No	No
Thallium	6.0	ND	1.3	NA	5.2	NA	0.23	NA	0.98	NA	Yes	No	Yes	No
Vanadium	127	281	26	55	26	NA	0.58	3.9	0.69	NA	Yes	Yes	Yes	No
Zinc	70	483	2,986	NA	NA	NA	0.13	NA	NA	NA	Yes	No	No	No

Table 4. Comparison of Site Data, Background Concentrations, PRGs, and MCLs for COCs in Area B.

Constituent	Background Concentration		Max Detect Concentration		Exposure Point Conc.		Risk-Based PRGs		MCL		Comments	
	Soil	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**	**Soil**	**GW**
Aluminum	11,500	73,400	23,400	NA	10,850	NA	38,000	NA	NA	NA	Max < PRG	Not COPC
Antimony	1.8	ND	9.5	2.9	7.3	2.9	13	6.0	NA	6.0	Max < PRG	Max < PRG, MCL
Arsenic	18	19	25	2.9	15	2.9	22	4.7	NA	10	UCL < PRG	Max < PRG, MCL
Cadmium	0.18	9.8	20	NA	11	NA	37	NA	NA	5	Max < PRG	Not COPC
Chromium	46.5	191	151	NA	59	NA	110	NA	NA	100	UCL < PRG	Not COPC
Copper	26	166	1,380	NA	467	NA	3,000	NA	NA	15	Max < PRG	Not COPC
Iron	21,700	193,026*	130,000	44,700	34,231	44,700	NC	NC	NA	NA	Intake < RDA	Intake < RDA, Max < background
Manganese	266	2,290	733	3,020	392	3,020	460	270	NA	NA	UCL < PRG	Site ≈ background
Thallium	6.0	ND	5.2	NA	5.2	NA	2.7	NA	NA	2	Max < background	Not COPC
Vanadium	127	281	38	NA	26	NA	19	NA	NA	NA	Max < background	Not COPC

Background concentrations 95% UCL (TetraTech, 2002).
* Recalculated because an error was noted on Tetra Tech report for 95%UCL value for iron.
NA – Not applicable
NC = not calculated; HQ exceeded 1 but was not selected as a COC.

Appendix F-2
RAGS Tables

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Trespasser/Visitor	Adolescent	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact site surface soil.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact site surface soil.
					Adult	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact site surface soil.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact site surface soil.
				Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers may be exposed to surface soil during maintenance activities, site inspections, or daily duties.
						Ingestion	On-site	Quant	Site workers may be exposed to surface soil during maintenance activities, site inspections, or daily duties.
		Air	Emissions from Area B, Site 11 Surface Soil	Trespasser/Visitor	Adolescent	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale emissions from soil.
					Adult	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale emissions from soil.
				Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors or fugitive dust from soil during maintenance activities, site inspections, or daily duties.
Future	Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Resident	Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child/Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
			Area B, Site 11 Shallow Aquifer	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction workers may contact groundwater while performing construction or excavation activities.
						Ingestion	On-site	None	Incidental ingestion of groundwater by construction workers would be minimal during construction or excavation activities.
		Air	Aquifer - Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child	Inhalation	On-site	None	Children are assumed not to shower.
					Child/Adult	Inhalation	On-site	None	Adult will be used to evaluate child/adult since children are assumed not to shower.
			Area B, Site 11 Shallow Aquifer - Volatilization	Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors from groundwater while performing construction or excavation activities.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil*	Soil*	Area B, Site 11 Soil*	Resident	Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child/Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
				Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction worker may be exposed to surface and subsurface soil during excavation activities.
						Ingestion	On-site	Quant	Construction worker may be exposed to surface and subsurface soil during excavation activities.
				Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers may be exposed to surface and subsurface soil during maintenance activities, site inspections, or daily duties.
						Ingestion	On-site	Quant	Site workers may be exposed to surface and subsurface soil during maintenance activities, site inspections, or daily duties.
				Trespasser/Visitor	Adolescent	Dermal Absorption	On-site	Quant	Trespasser/visitor may be exposed to surface and subsurface soil during excavation activities.
						Ingestion	On-site	Quant	Trespasser/visitor may be exposed to surface and subsurface soil during excavation activities.
					Adult	Dermal Absorption	On-site	Quant	Trespasser/visitor may be exposed to surface and subsurface soil during excavation activities.
						Ingestion	On-site	Quant	Trespasser/visitor may be exposed to surface and subsurface soil during excavation activities.
		Air	Emissions from Area B, Site 11 Soil*	Resident	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child/Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
				Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors or fugitive dust from soil during excavation activities.
				Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may be exposed to vapors or fugitive dust from Site 11 soils during maintenance activities, site inspections, or daily duties.
				Trespasser/Visitor	Adolescent	Inhalation	On-site	Quant	Trespassers/visitors may be exposed to vapors or fugitive dust from Site 11 soils.
					Adult	Inhalation	On-site	Quant	Trespassers/visitors may be exposed to vapors or fugitive dust from Site 11 soils.

* Surface and subsurface soil

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Area B, Site 11	67-64-1	Acetone	5.00E-03 J	5.00E-03 J	mg/kg	IS11SS520001	1/11	0.012 - 0.032	5.00E-03		7.04E+03 N	1.11E-01	SSL	NO	BSL
	74-83-9	Bromomethane	2.00E-03 J	2.00E-03 J	mg/kg	IS11SS500001 IS11SS530001	4/11	0.012 - 0.032	2.00E-03		1.10E+01 N	2.07E-04	SSL	NO	BSL
	74-87-3	Chloromethane	6.00E-04 J	7.00E-04 J	mg/kg	IS11SS500001	2/11	0.012 - 0.032	7.00E-04		NA	4.64E-03	SSL	NO	BSL
	110-82-7	Cyclohexane	8.00E-04 J	8.00E-04 J	mg/kg	IS11SS510001	1/11	0.012 - 0.032	8.00E-04		NA	NA	NA	NO	BSL
	75-09-2	Methylene chloride	8.00E-04 J	2.00E-03 J	mg/kg	IS11SS430001 IS11SS440001P	5/11	0.012 - 0.032	2.00E-03		8.52E+01 C	9.52E-04	SSL	NO	BSL
	91-57-6	2-Methylnaphthalene	1.40E-02 J	1.40E-02 J	mg/kg	IS11SS510001	1/11	0.4 - 1.1	1.40E-02		3.13E+01 N	2.22E-02	SSL	NO	BSL
	83-32-9	Acenaphthene	2.00E-02 J	3.70E-02 J	mg/kg	IS11SS450001	3/11	0.4 - 1.1	3.70E-02		4.69E+02 N	5.24E-01	SSL	NO	BSL
	208-96-8	Acenaphthylene	1.10E-02 J	6.80E-02 J	mg/kg	IS11SS450001	5/11	0.4 - 1.1	6.80E-02		1.56E+02 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.10E-02 J	2.00E-01 J	mg/kg	IS11SS440001P	7/11	0.4 - 1.1	2.00E-01		2.35E+03 N	2.33E+00	SSL	NO	BSL
	100-52-7	Benzaldehyde	9.00E-03 J	3.00E-02 J	mg/kg	IS11SS530001	6/11	0.4 - 1.1	3.00E-02		7.82E+02 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	5.40E-02 J	5.00E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	5.00E-01		8.75E-01 C	7.30E-02	SSL	NO	BSL
	50-32-8	Benzo(a)pyrene	5.60E-02 J	4.60E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	4.60E-01		8.75E-02 C	1.87E-02	SSL	YES	ASL
	205-99-2	Benzo(b)fluoranthene	9.00E-02 J	6.40E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	6.40E-01		8.75E-01 C	2.26E-01	SSL	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	6.10E-02 J	3.70E-01 J	mg/kg	IS11SS450001	5/11	0.4 - 1.1	3.70E-01		2.35E+02 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	7.20E-02 J	6.00E-01	mg/kg	IS11SS440001P	7/11	0.4 - 1.1	6.00E-01		8.75E+00 C	2.26E+00	SSL	NO	BSL
	86-74-8	Carbazole	1.30E-02 J	7.60E-02 J	mg/kg	IS11SS450001	4/11	0.4 - 1.1	7.60E-02		3.19E+01 C	2.34E-02	SSL	NO	BSL
	218-01-9	Chrysene	7.90E-02 J	6.60E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	6.60E-01		8.75E+01 C	7.30E+00	SSL	NO	BSL
	84-74-2	Di-n-butylphthalate	3.50E-02 J	3.50E-02 J	mg/kg	IS11SS440001	1/11	0.4 - 1.1	3.50E-02		7.82E+02 N	2.48E+01	SSL	NO	BSL
	117-84-0	Di-n-octylphthalate	1.60E-02 J	1.40E-01 J	mg/kg	IS11SS490001	4/11	0.4 - 1.1	1.40E-01		3.13E+02 N	2.43E+04	SSL	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.80E-02 J	1.70E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	1.70E-01		8.75E-02 C	6.97E-02	SSL	YES	ASL
	132-64-9	Dibenzofuran	1.30E-02 J	1.90E-02 J	mg/kg	IS11SS510001	2/11	0.4 - 1.1	1.90E-02		1.56E+01 N	1.91E-02	SSL	NO	BSL
	84-66-2	Diethylphthalate	3.80E-02 J	1.40E-01 J	mg/kg	IS11SS440001	2/11	0.4 - 1.1	1.40E-01		6.26E+03 N	2.27E+00	SSL	NO	BSL
	131-11-3	Dimethyl phthalate	3.80E-01 J	3.80E-01 J	mg/kg	IS11SS440001	1/11	0.4 - 1.1	3.80E-01		7.82E+04 N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	9.00E-03 J	9.60E-01 J	mg/kg	IS11SS440001P	10/11	0.4 - 1.1	9.60E-01		3.13E+02 N	3.13E+01	SSL	NO	BSL
	86-73-7	Fluorene	2.60E-02 J	4.90E-02 J	mg/kg	IS11SS450001	3/11	0.4 - 1.1	4.90E-02		3.13E+02 N	6.76E-01	SSL	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	4.30E-02 J	3.90E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	3.90E-01		8.75E-01 C	6.37E-01	SSL	NO	BSL
	91-20-3	Naphthalene	1.20E-02 J	1.80E-02 J	mg/kg	IS11SS510001	2/11	0.4 - 1.1	1.80E-02		1.56E+02 N	7.69E-04	SSL	NO	BSL
	85-01-8	Phenanthrene	2.40E-02 J	4.60E-01 J	mg/kg	IS11SS450001	7/11	0.4 - 1.1	4.60E-01		2.35E+02 N	NA	NA	NO	BSL
	129-00-0	Pyrene	7.70E-02 J	8.50E-01 J	mg/kg	IS11SS440001P	7/11	0.4 - 1.1	8.50E-01		2.35E+02 N	3.41E+00	SSL	NO	BSL
	55-63-0	Nitroglycerin	2.70E+01	2.70E+01	mg/kg	IS11SS440001P	1/11	10 - 10	2.70E+01		4.56E+01 C	NA	NA	NO	BSL
	14797-73-0	Perchlorate	1.40E+00	1.40E+00	mg/kg	IS11SS470001	1/11	0.08 - 0.16	1.40E+00		5.48E+00 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	6.10E+03	2.34E+04	mg/kg	IS11SS480001	11/11	46.62 - 80.808	2.34E+04		7.82E+03 N	NA	NA	YES	ASL
	7440-36-0	Antimony	3.90E-01 L	9.50E+00 L	mg/kg	IS11SS440001P	7/11	13.986 - 24.242	9.50E+00		3.13E+00 N	6.60E-02	SSL	YES	ASL
	7440-38-2	Arsenic	2.40E+00 K	2.55E+01	mg/kg	IS11SS480001	10/11	2.331 - 4.04	2.55E+01		4.26E-01 C	1.30E-03	SSL	YES	ASL
	7440-39-3	Barium	3.58E+01 J	1.27E+02	mg/kg	IS11SS440001P	11/11	46.62 - 80.808	1.27E+02		5.48E+02 N	1.05E+01	SSL	NO	BSL
	7440-41-7	Beryllium	2.10E-01 J	6.10E-01 J	mg/kg	IS11SS480001	11/11	1.166 - 2.02	6.10E-01		1.56E+01 N	5.77E+00	SSL	NO	BSL

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-43-9	Cadmium	1.10E-01 J	2.04E+01	mg/kg	IS11SS510001	9/11	1.166 - 2.02	2.04E+01		3.91E+00 N	1.37E-01	SSL	YES	ASL
	7440-70-2	Calcium	1.68E+02 J	8.13E+03	mg/kg	IS11SS450001	11/11	1165.5 - 2020.2	8.13E+03		NA	NA	NA	NO	NUT
	7440-47-3	Chromium	1.18E+01	1.51E+02 J	mg/kg	IS11SS510001	11/11	2.331 - 4.04	1.51E+02		2.35E+01 N	2.10E-01	SSL	YES	ASL
	7440-48-4	Cobalt	3.60E+00 J	1.55E+01	mg/kg	IS11SS510001	11/11	11.655 - 20.202	1.55E+01		1.56E+02 N	NA	NA	NO	BSL
	7440-50-8	Copper	8.10E+00 J	1.38E+03 K	mg/kg	IS11SS480001	11/11	5.828 - 10.101	1.38E+03		3.13E+02 N	5.26E+01	SSL	YES	ASL
	7439-89-6	Iron	1.45E+04	1.30E+05	mg/kg	IS11SS510001	11/11	23.541 - 46.62	1.30E+05		2.35E+03 N	NA	NA	YES	ASL
	7439-92-1	Lead	1.07E+01	1.24E+03	mg/kg	IS11SS440001P	11/11	0.699 - 1.212	1.24E+03		4.00E+02	NA	NA	YES	ASL
	7439-95-4	Magnesium	5.39E+02 J	1.80E+03 J	mg/kg	IS11SS450001	11/11	1165.5 - 2020.2	1.80E+03		NA	NA	NA	NO	NUT
	7439-96-5	Manganese	5.53E+01	7.33E+02 L	mg/kg	IS11SS510001	11/11	3.497 - 6.061	7.33E+02		1.56E+02 N	4.76E+00	SSL	YES	ASL
	7439-97-6	Mercury	9.00E-02 J	4.10E-01	mg/kg	IS11SS510001	6/11	0.084 - 0.202	4.10E-01		7.82E-01 N	NA	NA	NO	BSL
	7440-02-0	Nickel	6.50E+00 J	7.77E+01 J	mg/kg	IS11SS510001	11/11	9.324 - 16.162	7.77E+01		1.56E+02 N	NA	NA	NO	BSL
	7440-09-7	Potassium	3.80E+02 J	7.95E+02 J	mg/kg	IS11SS480001	11/11	1165.5 - 2020.2	7.95E+02		NA	NA	NA	NO	NUT
	7782-49-2	Selenium	9.90E-01 J	5.70E+00	mg/kg	IS11SS510001	11/11	1.166 - 2.02	5.70E+00		3.91E+01 N	9.49E-02	SSL	NO	BSL
	7440-22-4	Silver	5.60E-01 J	1.04E+01	mg/kg	IS11SS440001P	8/11	2.331 - 4.04	1.04E+01		3.91E+01 N	1.55E-01	SSL	NO	BSL
	7440-23-5	Sodium	1.98E+02 J	3.43E+03	mg/kg	IS11SS480001	11/11	1165.5 - 2020.2	3.43E+03		NA	NA	NA	NO	NUT
	7440-28-0	Thallium	5.20E+00 L	5.20E+00 L	mg/kg	IS11SS510001	1/6	2.331 - 4.04	5.20E+00		5.48E-01 N	1.82E-02	SSL	YES	ASL
	7440-62-2	Vanadium	1.98E+01	3.02E+01	mg/kg	IS11SS430001	11/11	11.655 - 20.202	3.02E+01		7.82E+00 N	3.65E+00	SSL	YES	ASL
	7440-66-6	Zinc	2.34E+01	1.99E+03 K	mg/kg	IS11SS480001	11/11	4.662 - 8.081	1.99E+03		2.35E+03 N	6.81E+01	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for Chromium VI used for total chromium.
The lead screening value is 400 mg/kg, the USEPA residential screening level.
RBC value for methylmercury used as surrogate for mercury.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
SSL = Soil screening level, dilution attenuation factor = 1 (RBC table, April 7, 2005)
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic

Table 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Area B, Site 11	67-64-1	Acetone	3.07E-04 J	3.07E-04 J	µg/m3	IS11SS520001	1/11	NA - Modeled	3.07E-04	NA	3.29E+02 N	NA	NA	NO	BSL
	74-83-9	Bromomethane	8.59E-04 J	8.59E-04 J	µg/m3	IS11SS500001 IS11SS530001	4/11	NA - Modeled	8.59E-04	NA	5.11E-01 N	NA	NA	NO	BSL
	74-87-3	Chloromethane	3.93E-04 J	4.59E-04 J	µg/m3	IS11SS500001	2/11	NA - Modeled	4.59E-04	NA	9.49E+00 N	NA	NA	NO	BSL
	110-82-7	Cyclohexane	5.63E-04 J	5.63E-04 J	µg/m3	IS11SS510001	1/11	NA - Modeled	5.63E-04	NA	6.21E+02 N	NA	NA	NO	BSL
	75-09-2	Methylene chloride	2.47E-04 J	6.19E-04 J	µg/m3	IS11SS430001 IS11SS440001P	5/11	NA - Modeled	6.19E-04	NA	3.79E+00 C	NA	NA	NO	BSL
	91-57-6	2-Methylnaphthalene	1.87E-04 J	1.87E-04 J	µg/m3	IS11SS510001	1/11	NA - Modeled	1.87E-04	NA	1.46E+00 N	NA	NA	NO	BSL
	83-32-9	Acenaphthene	7.06E-05 J	1.31E-04 J	µg/m3	IS11SS450001	3/11	NA - Modeled	1.31E-04	NA	2.19E+01 N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	8.33E-09 J	5.15E-08 J	µg/m3	IS11SS450001	5/11	NA - Modeled	5.15E-08	NA	3.29E-01 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.09E-05 J	1.98E-04 J	µg/m3	IS11SS440001P	7/11	NA - Modeled	1.98E-04	NA	1.10E+02 N	NA	NA	NO	BSL
	100-52-7	Benzaldehyde	6.82E-09 J	2.27E-08 J	µg/m3	IS11SS530001	6/11	NA - Modeled	2.27E-08	NA	3.65E+01 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	4.09E-08 J	3.79E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	3.79E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	4.24E-08 J	3.48E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	3.48E-07	NA	2.02E-03 C	NA	NA	NO	BSL
	205-99-2	Benzo(b)fluoranthene	6.82E-08 J	4.85E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	4.85E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	4.62E-08 J	2.80E-07 J	µg/m3	IS11SS450001	5/11	NA - Modeled	2.80E-07	NA	1.10E+01 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	5.45E-08 J	4.55E-07	µg/m3	IS11SS440001P	7/11	NA - Modeled	4.55E-07	NA	8.58E-02 C	NA	NA	NO	BSL
	86-74-8	Carbazole	9.85E-09 J	5.76E-08 J	µg/m3	IS11SS450001	4/11	NA - Modeled	5.76E-08	NA	3.13E-01 C	NA	NA	NO	BSL
	218-01-9	Chrysene	5.98E-08 J	5.00E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	5.00E-07	NA	8.58E-01 C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	2.65E-08 J	2.65E-08 J	µg/m3	IS11SS440001	1/11	NA - Modeled	2.65E-08	NA	3.65E+01 N	NA	NA	NO	BSL
	117-84-0	Di-n-octylphthalate	1.21E-08 J	1.06E-07 J	µg/m^3	IS11SS490001	4/11	NA - Modeled	1.06E-07	NA	1.46E+01 N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.36E-08 J	1.29E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	1.29E-07	NA	8.58E-04 C	NA	NA	NO	BSL
	132-64-9	Dibenzofuran	5.00E-05 J	7.30E-05 J	µg/m3	IS11SS510001	2/11	NA - Modeled	7.30E-05	NA	7.30E-01 N	NA	NA	NO	BSL
	84-66-2	Diethylphthalate	2.88E-08 J	1.06E-07 J	µg/m3	IS11SS440001	2/11	NA - Modeled	1.06E-07	NA	2.92E+02 N	NA	NA	NO	BSL
	131-11-3	Dimethyl phthalate	2.88E-07 J	2.88E-07 J	µg/m3	IS11SS440001	1/11	NA - Modeled	2.88E-07	NA	3.65E+03 N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	6.82E-09 J	7.27E-07 J	µg/m3	IS11SS440001P	10/11	NA - Modeled	7.27E-07	NA	1.46E+01 N	NA	NA	NO	BSL
	86-73-7	Fluorene	3.93E-05 J	7.40E-05 J	µg/m3	IS11SS450001	3/11	NA - Modeled	7.40E-05	NA	1.46E+01 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	3.26E-08 J	2.95E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	2.95E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	91-20-3	Naphthalene	1.66E-04 J	2.49E-04 J	µg/m3	IS11SS510001	2/11	NA - Modeled	2.49E-04	NA	3.29E-01 N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	1.82E-08 J	3.48E-07 J	µg/m3	IS11SS450001	7/11	NA - Modeled	3.48E-07	NA	1.10E+01 N	NA	NA	NO	BSL
	129-00-0	Pyrene	1.57E-05 J	1.73E-04 J	µg/m3	IS11SS440001P	7/11	NA - Modeled	1.73E-04	NA	1.10E+01 N	NA	NA	NO	BSL
	55-63-0	Nitroglycerin	2.05E-05	2.05E-05	µg/m3	IS11SS440001P	1/11	NA - Modeled	2.05E-05	NA	4.47E-01 C	NA	NA	NO	BSL
	14797-73-0	Perchlorate	1.06E-06	1.06E-06	µg/m3	IS11SS470001	1/11	NA - Modeled	1.06E-06	NA	2.56E-01 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	4.62E-03	1.77E-02	µg/m3	IS11SS480001	11/11	NA - Modeled	1.77E-02	NA	3.65E-01 N	NA	NA	NO	BSL
	7440-36-0	Antimony	2.95E-07 L	7.20E-06 L	µg/m3	IS11SS440001P	7/11	NA - Modeled	7.20E-06	NA	1.46E-01 N	NA	NA	NO	BSL
	7440-38-2	Arsenic	1.82E-06 K	1.93E-05	µg/m3	IS11SS480001	10/11	NA - Modeled	1.93E-05	NA	4.15E-04 C	NA	NA	NO	BSL
	7440-39-3	Barium	2.71E-05 J	9.62E-05	µg/m3	IS11SS440001P	11/11	NA - Modeled	9.62E-05	NA	5.11E-02 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	1.59E-07 J	4.62E-07 J	µg/m3	IS11SS480001	11/11	NA - Modeled	4.62E-07	NA	7.45E-04 C	NA	NA	NO	BSL

Table 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-43-9	Cadmium	8.33E-08 J	1.55E-05	µg/m3	IS11SS510001	9/11	NA - Modeled	1.55E-05	NA	9.94E-04 C	NA	NA	NO	BSL
	7440-70-2	Calcium	1.27E-04 J	6.16E-03	µg/m3	IS11SS450001	11/11	NA - Modeled	6.16E-03	NA	NA	NA	NA	NO	NUT
	7440-47-3	Chromium	8.94E-06	1.14E-04 J	µg/m3	IS11SS510001	11/11	NA - Modeled	1.14E-04	NA	1.53E-04 C	NA	NA	NO	BSL
	7440-48-4	Cobalt	2.73E-06 J	1.17E-05	µg/m3	IS11SS510001	11/11	NA - Modeled	1.17E-05	NA	6.39E-04 C	NA	NA	NO	BSL
	7440-50-8	Copper	6.14E-06 J	1.05E-03 K	µg/m3	IS11SS480001	11/11	NA - Modeled	1.05E-03	NA	1.46E+01 N	NA	NA	NO	BSL
	7439-89-6	Iron	1.10E-02	9.85E-02	µg/m3	IS11SS510001	11/11	NA - Modeled	9.85E-02	NA	1.10E+02 N	NA	NA	NO	BSL
	7439-92-1	Lead	8.11E-06	9.39E-04	µg/m3	IS11SS440001P	11/11	NA - Modeled	9.39E-04	NA	NA	NA	NA	NO	BSL
	7439-95-4	Magnesium	4.08E-04 J	1.36E-03 J	µg/m3	IS11SS450001	11/11	NA - Modeled	1.36E-03	NA	NA	NA	NA	NO	NUT
	7439-96-5	Manganese	4.19E-05	5.55E-04 L	µg/m3	IS11SS510001	11/11	NA - Modeled	5.55E-04	NA	5.22E-03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	6.82E-08 J	3.11E-07	µg/m3	IS11SS510001	6/11	NA - Modeled	3.11E-07	NA	3.14E-02 N	NA	NA	NO	BSL
	7440-02-0	Nickel	4.92E-06 J	5.89E-05 J	µg/m3	IS11SS510001	11/11	NA - Modeled	5.89E-05	NA	7.30E+00 N	NA	NA	NO	BSL
	7440-09-7	Potassium	2.88E-04 J	6.02E-04 J	µg/m3	IS11SS480001	11/11	NA - Modeled	6.02E-04	NA	NA	NA	NA	NO	NUT
	7782-49-2	Selenium	7.50E-07 J	4.32E-06	µg/m3	IS11SS510001	11/11	NA - Modeled	4.32E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-22-4	Silver	4.24E-07 J	7.88E-06	µg/m3	IS11SS440001P	8/11	NA - Modeled	7.88E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-23-5	Sodium	1.50E-04 J	2.60E-03	µg/m3	IS11SS480001	11/11	NA - Modeled	2.60E-03	NA	NA	NA	NA	NO	NUT
	7440-28-0	Thallium	3.94E-06 L	3.94E-06 L	µg/m3	IS11SS510001	1/6	NA - Modeled	3.94E-06	NA	2.56E-02 N	NA	NA	NO	BSL
	7440-62-2	Vanadium	1.50E-05	2.29E-05	µg/m3	IS11SS430001	11/11	NA - Modeled	2.29E-05	NA	3.65E-01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	1.77E-05	1.51E-03 K	µg/m3	IS11SS480001	11/11	NA - Modeled	1.51E-03	NA	1.10E+02 N	NA	NA	NO	BSL

[1] Minimum/Maximum calculated air concentrations from soil concentrations. Air concentrations calculated as Cair = Csoil*1000*(1/PEF+1/VF)
VF only included in calculation for VOCs. VF calculated on Table 2.2A. PEF = 1.32E+09 m3/kg.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for Chromium VI used for total chromium.
The lead screening value is 400 mg/kg, the USEPA residential screening level.
RBC value for elemental mercury used as surrogate for mercury.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered

J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic

Table 2.2 and 2.4 Supplement A
Calculation of Volatilization Factor
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical	Diffusivity in Air (D_i) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_w) (cm^2/s)	Soil Organic Carbon Partition Coeff. (K_{oc}) (cm^3/g)	Soil Water Partition Coeff. ($K_d = K_{oc} \times F_{oc}$) ($g/cm^3$)	Solubility in Water (S) (mg/L)	Apparent Diffusivity (D_A) (cm^2/s)	Volatilization Factor (VF) (m^3/kg)	Soil Saturatio Concentratio (C_{sat}) (mg/kg)
Volatile Organics									
Acetone	1.24E-01	1.59E-03	1.14E-05	5.75E-01	3.45E-03	1.00E+06	1.02E-04	1.63E+04	1.04E+05
Bromomethane	7.30E-02	2.60E-01	1.20E-05	9.00E+00	5.40E-02	1.50E+04	4.98E-03	2.33E+03	3.05E+03
Carbon disulfide	1.04E-01	1.24E+00	1.00E-05	4.57E+01	2.74E-01	1.19E+03	1.13E-02	1.55E+03	7.25E+02
Chloromethane	1.10E-01	9.80E-01	6.50E-06	3.50E+01	2.10E-01	8.20E+03	1.16E-02	1.53E+03	4.06E+03
Cyclohexane	8.00E-02	8.20E+00	9.00E-06	1.60E+02	9.60E-01	5.50E+01	1.34E-02	1.42E+03	1.44E+02
Methylene chloride	1.01E-01	8.98E-02	1.17E-05	1.17E+01	7.02E-02	1.30E+04	2.58E-03	3.23E+03	2.43E+03
Trichloroethene	7.90E-02	4.22E-01	9.10E-06	1.66E+02	9.96E-01	1.10E+03	1.51E-03	4.23E+03	1.29E+03
Semivolatile Organics									
2-Methylnaphthalene	5.60E-02	2.07E-02	7.84E-06	2.13E+03	1.28E+01	2.54E+01	4.80E-06	7.50E+04	3.27E+02
Acenaphthene	4.21E-02	6.36E-03	7.69E-06	7.08E+03	4.25E+01	4.24E+00	3.36E-07	2.83E+05	1.81E+02
Anthracene	3.24E-02	2.67E-03	7.74E-06	2.95E+04	1.77E+02	4.34E-02	2.63E-08	1.01E+06	7.69E+00
Dibenzofuran	6.19E-02	3.98E-03		5.48E+03	3.29E+01	5.65E+00	3.98E-07	2.60E+05	1.86E+02
Fluorene	3.63E-02	2.61E-03	7.88E-06	1.38E+04	8.28E+01	1.98E+00	6.15E-08	6.63E+05	1.64E+02
Naphthalene	5.90E-02	1.98E-02	7.50E-06	2.00E+03	1.20E+01	3.10E+01	5.15E-06	7.24E+04	3.75E+02
Pyrene	2.72E-02	4.51E-04	7.24E-06	1.05E+05	6.30E+02	1.35E-01	1.11E-09	4.93E+06	8.51E+01

Volatilization factor (VF) = (m^3/kg)
$$VF = \frac{Q/C \times (3.14 \times D_A \times T)^{1/2} \times 10^{-4}\ m^2/cm^2}{2 \times r_b \times D_A}$$

Apparent Diffusivity (D_A) = (cm^2/s)
$$D_A = \frac{[(Q_a^{10/3} \times D_i \times H' + Q_w^{10/3} \times D_w)/n^2]}{(r_b \times K_d + Q_w + Q_a \times H')}$$

Soil Saturation Concentration (C_{sat}) =
$$S/r_b \times (K_d \times r_b + Q_w + H' \times Q_a)$$

Parameters	Values
Q/C - Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	90.24
T - Exposure interval(s)	9.5E+08
r_b - Soil bulk density (g/cm^3)	1.5
Q_a - Air-filled soil porosity (L_{air}/L_{water}) = n - Q_w	0.28
n - Total soil porosity (Lpore/Lsoil) = 1 - (r_b/r_s)	0.43
Q_w - Water-filled soil porosity (Lwater/Lsoil)	0.15
r_s - Soil particle density (g/cm^3)	2.65
f_{oc} - fraction organic carbon in soil (g/g)	0.006

Equations and chemical properties from USEPA, 1996. *Soil Screening Guidance: User's Guide.* EPA/540/R-96/018.

Table 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration	Qualifier	Maximum [1] Concentration	Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Area B, Site 11	67-64-1	Acetone	5.00E-03	J	4.80E-02	J	mg/kg	IS11SB490002P	5/20	0.011 - 0.032	4.80E-02		7.04E+03	N	1.11E-01	SSL	NO	BSL
	74-83-9	Bromomethane	2.00E-03	J	2.00E-03	J	mg/kg	IS11SB530002 IS11SS530001	5/20	0.011 - 0.032	2.00E-03		1.10E+01	N	2.07E-04	SSL	NO	BSL
	75-15-0	Carbon disulfide	1.00E-03	J	1.00E-03	J	mg/kg	IS11SB490002P	1/20	0.011 - 0.032	1.00E-03		7.82E+02	N	9.50E-02	SSL	NO	BSL
	74-87-3	Chloromethane	6.00E-04	J	7.00E-04	J	mg/kg	IS11SS500001	2/20	0.011 - 0.032	7.00E-04		NA		4.64E-03	SSL	NO	BSL
	110-82-7	Cyclohexane	8.00E-04	J	1.00E-03	J	mg/kg	IS11SB480002	2/20	0.011 - 0.032	1.00E-03		NA		NA	NA	NO	BSL
	75-09-2	Methylene chloride	8.00E-04	J	3.00E-03	J	mg/kg	IS11SB440002	9/20	0.011 - 0.032	3.00E-03		8.52E+01	C	9.52E-04	SSL	NO	BSL
	79-01-6	Trichloroethene	9.00E-04	J	9.00E-04	J	mg/kg	IS11SB510002	1/20	0.011 - 0.032	9.00E-04		1.60E+00	C	1.31E-05	SSL	NO	BSL
	91-57-6	2-Methylnaphthalene	1.20E-02	J	6.70E-02	J	mg/kg	IS11SB510002	5/20	0.38 - 1.1	6.70E-02		3.13E+01	N	2.22E-02	SSL	NO	BSL
	83-32-9	Acenaphthene	1.70E-02	J	6.80E-02	J	mg/kg	IS11SB440002	5/20	0.38 - 1.1	6.80E-02		4.69E+02	N	5.24E-01	SSL	NO	BSL
	208-96-8	Acenaphthylene	1.10E-02	J	3.10E-01	J	mg/kg	IS11SB440002	9/20	0.38 - 1.1	3.10E-01		1.56E+02	N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.10E-02	J	4.20E-01	J	mg/kg	IS11SB440002	12/20	0.38 - 1.1	4.20E-01		2.35E+03	N	2.33E+00	SSL	NO	BSL
	100-52-7	Benzaldehyde	8.00E-03	J	4.70E-02	J	mg/kg	IS11SB440002	14/20	0.38 - 1.1	4.70E-02		7.82E+02	N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	2.10E-02	J	1.40E+00		mg/kg	IS11SB440002	13/20	0.38 - 1.1	1.40E+00		8.75E-01	C	7.30E-02	SSL	YES	ASL
	50-32-8	Benzo(a)pyrene	2.10E-02	J	1.10E+00		mg/kg	IS11SB440002	14/20	0.38 - 1.1	1.10E+00		8.75E-02	C	1.87E-02	SSL	YES	ASL
	205-99-2	Benzo(b)fluoranthene	1.80E-02	J	1.50E+00		mg/kg	IS11SB440002	14/20	0.38 - 1.1	1.50E+00		8.75E-01	C	2.26E-01	SSL	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	6.10E-02	J	6.00E-01		mg/kg	IS11SB440002	10/20	0.38 - 1.1	6.00E-01		2.35E+02	N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	2.30E-02	J	1.10E+00		mg/kg	IS11SB440002	13/20	0.38 - 1.1	1.10E+00		8.75E+00	C	2.26E+00	SSL	NO	BSL
	85-68-7	Butylbenzylphthalate	1.10E-02	J	1.10E-02	J	mg/kg	IS11SB510002	1/20	0.38 - 1.1	1.10E-02		3.36E+02	C	4.06E+00	SSL	NO	BSL
	86-74-8	Carbazole	1.30E-02	J	8.00E-02	J	mg/kg	IS11SB440002	8/20	0.38 - 1.1	8.00E-02		3.19E+01	C	2.34E-02	SSL	NO	BSL
	218-01-9	Chrysene	3.00E-02	J	1.40E+00		mg/kg	IS11SB440002	13/20	0.38 - 1.1	1.40E+00		8.75E+01	C	7.30E+00	SSL	NO	BSL
	84-74-2	Di-n-butylphthalate	3.50E-02	J	3.50E-02	J	mg/kg	IS11SS440001	1/20	0.38 - 1.1	3.50E-02		7.82E+02	N	2.48E+01	SSL	NO	BSL
	117-84-0	Di-n-octylphthalate	1.20E-02	J	1.60E-01	J	mg/kg	IS11SB510002	7/20	0.38 - 1.1	1.60E-01		3.13E+02	N	2.43E+04	SSL	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.80E-02	J	3.60E-01	J	mg/kg	IS11SB440002	12/20	0.38 - 1.1	3.60E-01		8.75E-02	C	6.97E-02	SSL	YES	ASL
	132-64-9	Dibenzofuran	9.00E-03	J	3.60E-02	J	mg/kg	IS11SB440002	4/20	0.38 - 1.1	3.60E-02		1.56E+01	N	1.91E-02	SSL	NO	BSL
	84-66-2	Diethylphthalate	1.80E-02	J	3.70E-01	J	mg/kg	IS11SB510002	4/20	0.38 - 1.1	3.70E-01		6.26E+03	N	2.27E+00	SSL	NO	BSL
	131-11-3	Dimethyl phthalate	3.80E-01	J	3.80E-01	J	mg/kg	IS11SS440001	1/20	0.38 - 1.1	3.80E-01		7.82E+04	N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	9.00E-03	J	2.90E+00		mg/kg	IS11SB440002	17/20	0.38 - 1.1	2.90E+00		3.13E+02	N	3.13E+01	SSL	NO	BSL
	86-73-7	Fluorene	1.30E-02	J	8.80E-02	J	mg/kg	IS11SB440002	5/20	0.38 - 1.1	8.80E-02		3.13E+02	N	6.76E-01	SSL	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.80E-02	J	7.50E-01		mg/kg	IS11SB440002	14/20	0.38 - 1.1	7.50E-01		8.75E-01	C	6.37E-01	SSL	NO	BSL
	91-20-3	Naphthalene	1.20E-02	J	3.60E-02	J	mg/kg	IS11SB510002	6/20	0.38 - 1.1	3.60E-02		1.56E+02	N	7.69E-04	SSL	NO	BSL
	85-01-8	Phenanthrene	1.60E-02	J	6.00E-01		mg/kg	IS11SB440002	13/20	0.38 - 1.1	6.00E-01		2.35E+02	N	NA	NA	NO	BSL
	129-00-0	Pyrene	2.70E-02	J	2.20E+00		mg/kg	IS11SB440002	14/20	0.38 - 1.1	2.20E+00		2.35E+02	N	3.41E+00	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	4.50E+00	D	4.50E+00	D	mg/kg	IS11SB520406	1/20	0.38 - 1.2	4.50E+00		4.56E+01	C	1.44E+02	SSL	NO	BSL
	55-63-0	Nitroglycerin	2.70E+01		2.70E+01		mg/kg	IS11SS440001P	1/20	10 - 10	2.70E+01		4.56E+01	C	NA	NA	NO	BSL
	14797-73-0	Perchlorate	1.40E+00		1.40E+00		mg/kg	IS11SS470001 IS11SS470001P	1/20	0.08 - 0.16	1.40E+00		5.48E+00	N	NA	NA	NO	BSL
	7429-90-5	Aluminum	4.77E+03		2.34E+04		mg/kg	IS11SS480001	20/20	43.021 - 80.808	2.34E+04		7.82E+03	N	NA	NA	YES	ASL

Table 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-36-0	Antimony	3.90E-01 L	9.50E+00 L	mg/kg	IS11SS440001P	12/20	12.906 - 24.242	9.50E+00		3.13E+00 N	6.60E-02	SSL	YES	ASL
	7440-38-2	Arsenic	2.30E+00 K	2.55E+01	mg/kg	IS11SS480001	19/20	2.151 - 4.04	2.55E+01		4.26E-01 C	1.30E-03	SSL	YES	ASL
	7440-39-3	Barium	3.58E+01 J	1.27E+02	mg/kg	IS11SB490002P	20/20	43.021 - 80.808	1.27E+02		5.48E+02 N	1.05E+01	SSL	NO	BSL
	7440-41-7	Beryllium	2.10E-01 J	8.30E-01 J	mg/kg	IS11SB500608	20/20	1.076 - 2.02	8.30E-01		1.56E+01 N	5.77E+00	SSL	NO	BSL
	7440-43-9	Cadmium	1.10E-01 J	2.04E+01	mg/kg	IS11SS510001	16/20	1.076 - 2.02	2.04E+01		3.91E+00 N	1.37E-01	SSL	YES	ASL
	7440-70-2	Calcium	1.68E+02 J	3.56E+04	mg/kg	IS11SB490002P	20/20	1075.53 - 2020.2	3.56E+04		NA	NA	NA	NO	NUT
	7440-47-3	Chromium	9.50E+00 J	1.51E+02 J	mg/kg	IS11SS510001	20/20	2.151 - 4.04	1.51E+02		2.35E+01 N	2.10E-01	SSL	YES	ASL
	7440-48-4	Cobalt	3.60E+00 J	1.55E+01	mg/kg	IS11SS510001	20/20	10.755 - 20.202	1.55E+01		1.56E+02 N	NA	NA	NO	BSL
	7440-50-8	Copper	5.80E+00 J	1.38E+03 K	mg/kg	IS11SS480001	20/20	5.378 - 10.101	1.38E+03		3.13E+02 N	5.26E+01	SSL	YES	ASL
	7439-89-6	Iron	7.19E+03	1.30E+05	mg/kg	IS11SS510001	20/20	21.511 - 46.62	1.30E+05		2.35E+03 N	NA	NA	YES	ASL
	7439-92-1	Lead	9.30E+00	1.24E+03	mg/kg	IS11SS440001P	20/20	0.645 - 1.212	1.24E+03		4.00E+02	NA	NA	YES	ASL
	7439-95-4	Magnesium	3.73E+02 J	2.39E+03	mg/kg	IS11SB490002	20/20	1075.53 - 2020.2	2.39E+03		NA	NA	NA	NO	NUT
	7439-96-5	Manganese	5.53E+01	7.33E+02 L	mg/kg	IS11SS510001	20/20	3.227 - 6.061	7.33E+02		1.56E+02 N	4.76E+00	SSL	YES	ASL
	7439-97-6	Mercury	7.00E-02 J	4.10E-01	mg/kg	IS11SS510001	13/20	0.078 - 0.202	4.10E-01		7.82E-01 N	NA	NA	NO	BSL
	7440-02-0	Nickel	5.30E+00 J	7.77E+01 J	mg/kg	IS11SS510001	20/20	8.604 - 16.162	7.77E+01		1.56E+02 N	NA	NA	NO	BSL
	7440-09-7	Potassium	2.31E+02 J	7.95E+02 J	mg/kg	IS11SS480001	20/20	1075.53 - 2020.2	7.95E+02		NA	NA	NA	NO	NUT
	7782-49-2	Selenium	8.60E-01 J	5.70E+00	mg/kg	IS11SS510001	20/20	1.076 - 2.02	5.70E+00		3.91E+01 N	9.49E-02	SSL	NO	BSL
	7440-22-4	Silver	2.10E-01 J	1.04E+01	mg/kg	IS11SS440001P	15/20	2.151 - 4.04	1.04E+01		3.91E+01 N	1.55E-01	SSL	NO	BSL
	7440-23-5	Sodium	1.98E+02 J	3.43E+03	mg/kg	IS11SS480001	20/20	1075.53 - 2020.2	3.43E+03		NA	NA	NA	NO	NUT
	7440-28-0	Thallium	5.20E+00 L	5.20E+00 L	mg/kg	IS11SS510001	1/6	2.331 - 4.04	5.20E+00		5.48E-01 N	1.82E-02	SSL	YES	ASL
	7440-62-2	Vanadium	1.70E+01	3.83E+01	mg/kg	IS11SB490002	20/20	10.755 - 20.202	3.83E+01		7.82E+00 N	3.65E+00	SSL	YES	ASL
	7440-66-6	Zinc	2.15E+01	1.99E+03 K	mg/kg	IS11SS480001	20/20	4.302 - 8.081	1.99E+03		2.35E+03 N	6.81E+01	SSL	NO	BSL

* Surface soil & subsurface soil combined

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for Chromium VI used for total chromium.
The lead screening value is 400 mg/kg, the USEPA residential screening level.
RBC value for methylmercury used as surrogate for mercury.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)

SQL = Sample Quantification Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
L = Biased Low

Table 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Area B, Site 11	67-64-1	Acetone	3.07E-04 J	2.95E-03 J	µg/m3	IS11SB490002P	5/20	NA - Modeled	2.95E-03	NA	3.29E+02 N	NA	NA	NO	BSL
	74-83-9	Bromomethane	8.59E-04 J	8.59E-04 J	µg/m3	IS11SB530002 IS11SS530001	5/20	NA - Modeled	8.59E-04	NA	5.11E-01 N	NA	NA	NO	BSL
	75-15-0	Carbon disulfide	6.47E-04 J	6.47E-04 J	µg/m3	IS11SB490002P	1/20	NA - Modeled	6.47E-04	NA	7.30E+01 N	NA	NA	NO	BSL
	74-87-3	Chloromethane	3.93E-04 J	4.59E-04 J	µg/m3	IS11SS500001	2/20	NA - Modeled	4.59E-04	NA	9.49E+00 N	NA	NA	NO	BSL
	110-82-7	Cyclohexane	5.63E-04 J	7.04E-04 J	µg/m3	IS11SB480002	2/20	NA - Modeled	7.04E-04	NA	6.21E+02 N	NA	NA	NO	BSL
	75-09-2	Methylene chloride	2.47E-04 J	9.28E-04 J	µg/m3	IS11SB440002	9/20	NA - Modeled	9.28E-04	NA	3.79E+00 C	NA	NA	NO	BSL
	79-01-6	Trichloroethene	2.13E-04 J	2.13E-04 J	µg/m3	IS11SB510002	1/20	NA - Modeled	2.13E-04	NA	1.57E-02 C	NA	NA	NO	BSL
	91-57-6	2-Methylnaphthalene	1.60E-04 J	8.93E-04 J	µg/m3	IS11SB510002	5/20	NA - Modeled	8.93E-04	NA	1.46E+00 N	NA	NA	NO	BSL
	83-32-9	Acenaphthene	6.00E-05 J	2.40E-04 J	µg/m3	IS11SB440002	5/20	NA - Modeled	2.40E-04	NA	2.19E+01 N	NA	NA	NO	BSL
	208-96-8	Acenaphthylene	8.33E-09 J	2.35E-07 J	µg/m3	IS11SB440002	9/20	NA - Modeled	2.35E-07	NA	3.29E-01 N	NA	NA	NO	BSL
	120-12-7	Anthracene	1.09E-05 J	4.15E-04 J	µg/m3	IS11SB440002	12/20	NA - Modeled	4.15E-04	NA	1.10E+02 N	NA	NA	NO	BSL
	100-52-7	Benzaldehyde	6.06E-09 J	3.56E-08 J	µg/m3	IS11SB440002	14/20	NA - Modeled	3.56E-08	NA	3.65E+01 N	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	1.59E-08 J	1.06E-06	µg/m3	IS11SB440002	13/20	NA - Modeled	1.06E-06	NA	8.58E-03 C	NA	NA	NO	BSL
	50-32-8	Benzo(a)pyrene	1.59E-08 J	8.33E-07	µg/m3	IS11SB440002	14/20	NA - Modeled	8.33E-07	NA	2.02E-03 C	NA	NA	NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.36E-08 J	1.14E-06	µg/m3	IS11SB440002	14/20	NA - Modeled	1.14E-06	NA	8.58E-03 C	NA	NA	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	4.62E-08 J	4.55E-07	µg/m3	IS11SB440002	10/20	NA - Modeled	4.55E-07	NA	1.10E+01 N	NA	NA	NO	BSL
	207-08-9	Benzo(k)fluoranthene	1.74E-08 J	8.33E-07	µg/m3	IS11SB440002	13/20	NA - Modeled	8.33E-07	NA	8.58E-02 C	NA	NA	NO	BSL
	85-68-7	Butylbenzylphthalate	8.33E-09 J	8.33E-09 J	µg/m3	IS11SB510002	1/20	NA - Modeled	8.33E-09	NA	3.30E+00 C	NA	NA	NO	BSL
	86-74-8	Carbazole	9.85E-09 J	6.06E-08 J	µg/m3	IS11SB440002	8/20	NA - Modeled	6.06E-08	NA	3.13E-01 C	NA	NA	NO	BSL
	218-01-9	Chrysene	2.27E-08 J	1.06E-06	µg/m3	IS11SB440002	13/20	NA - Modeled	1.06E-06	NA	8.58E-01 C	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	2.65E-08 J	2.65E-08 J	µg/m3	IS11SS440001	1/20	NA - Modeled	2.65E-08	NA	3.65E+01 N	NA	NA	NO	BSL
	117-84-0	Di-n-octylphthalate	9.09E-09 J	1.21E-07 J	µg/m3	IS11SB510002	7/20	NA - Modeled	1.21E-07	NA	1.46E+01 N	NA	NA	NO	BSL
	53-70-3	Dibenz(a,h)anthracene	1.36E-08 J	2.73E-07 J	µg/m3	IS11SB440002	12/20	NA - Modeled	2.73E-07	NA	8.58E-04 C	NA	NA	NO	BSL
	132-64-9	Dibenzofuran	3.46E-05 J	1.38E-04 J	µg/m3	IS11SB440002	4/20	NA - Modeled	1.38E-04	NA	7.30E-01 N	NA	NA	NO	BSL
	84-66-2	Diethylphthalate	1.36E-08 J	2.80E-07 J	µg/m3	IS11SB510002	4/20	NA - Modeled	2.80E-07	NA	2.92E+02 N	NA	NA	NO	BSL
	131-11-3	Dimethyl phthalate	2.88E-07 J	2.88E-07 J	µg/m3	IS11SS440001	1/20	NA - Modeled	2.88E-07	NA	3.65E+03 N	NA	NA	NO	BSL
	206-44-0	Fluoranthene	6.82E-09 J	2.20E-06	µg/m3	IS11SB440002	17/20	NA - Modeled	2.20E-06	NA	1.46E+01 N	NA	NA	NO	BSL
	86-73-7	Fluorene	1.96E-05 J	1.33E-04 J	µg/m3	IS11SB440002	5/20	NA - Modeled	1.33E-04	NA	1.46E+01 N	NA	NA	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.36E-08 J	5.68E-07	µg/m3	IS11SB440002	14/20	NA - Modeled	5.68E-07	NA	8.58E-03 C	NA	NA	NO	BSL
	91-20-3	Naphthalene	1.66E-04 J	4.97E-04 J	µg/m3	IS11SB510002	6/20	NA - Modeled	4.97E-04	NA	3.29E-01 N	NA	NA	NO	BSL
	85-01-8	Phenanthrene	1.21E-08 J	4.55E-07	µg/m3	IS11SB440002	13/20	NA - Modeled	4.55E-07	NA	1.10E+01 N	NA	NA	NO	BSL
	129-00-0	Pyrene	5.50E-06 J	4.48E-04	µg/m3	IS11SB440002	14/20	NA - Modeled	4.48E-04	NA	1.10E+01 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	3.41E-06 D	3.41E-06 D	µg/m3	IS11SB520406	1/20	NA - Modeled	3.41E-06	NA	4.47E-01 C	NA	NA	NO	BSL
	55-63-0	Nitroglycerin	2.05E-05	2.05E-05	µg/m3	IS11SS440001P	1/20	NA - Modeled	2.05E-05	NA	4.47E-01 C	NA	NA	NO	BSL
	14797-73-0	Perchlorate	1.06E-06	1.06E-06	µg/m3	IS11SS470001 IS11SS470001P	1/20	NA - Modeled	1.06E-06	NA	2.56E-01 N	NA	NA	NO	BSL
	7429-90-5	Aluminum	3.61E-03	1.77E-02	µg/m3	IS11SS480001	20/20	NA - Modeled	1.77E-02	NA	3.65E-01 N	NA	NA	NO	BSL

Table 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-36-0	Antimony	2.95E-07 L	7.20E-06 L	µg/m3	IS11SS440001P	12/20	NA - Modeled	7.20E-06	NA	1.46E-01 N	NA	NA	NO	BSL
	7440-38-2	Arsenic	1.74E-06 K	1.93E-05	µg/m3	IS11SS480001	19/20	NA - Modeled	1.93E-05	NA	4.15E-04 C	NA	NA	NO	BSL
	7440-39-3	Barium	2.71E-05 J	9.62E-05	µg/m3	IS11SB490002P	20/20	NA - Modeled	9.62E-05	NA	5.11E-02 N	NA	NA	NO	BSL
	7440-41-7	Beryllium	1.59E-07 J	6.29E-07 J	µg/m3	IS11SB500608	20/20	NA - Modeled	6.29E-07	NA	7.45E-04 C	NA	NA	NO	BSL
	7440-43-9	Cadmium	8.33E-08 J	1.55E-05	µg/m3	IS11SS510001	16/20	NA - Modeled	1.55E-05	NA	9.94E-04 C	NA	NA	NO	BSL
	7440-70-2	Calcium	1.27E-04 J	2.70E-02	µg/m3	IS11SB490002P	20/20	NA - Modeled	2.70E-02	NA	NA	NA	NA	NO	NUT
	7440-47-3	Chromium	7.20E-06 J	1.14E-04 J	µg/m3	IS11SS510001	20/20	NA - Modeled	1.14E-04	NA	1.53E-04 C	NA	NA	NO	BSL
	7440-48-4	Cobalt	2.73E-06 J	1.17E-05	µg/m3	IS11SS510001	20/20	NA - Modeled	1.17E-05	NA	6.39E-04 C	NA	NA	NO	BSL
	7440-50-8	Copper	4.39E-06 J	1.05E-03 K	µg/m3	IS11SS480001	20/20	NA - Modeled	1.05E-03	NA	1.46E+01 N	NA	NA	NO	BSL
	7439-89-6	Iron	5.45E-03	9.85E-02	µg/m3	IS11SS510001	20/20	NA - Modeled	9.85E-02	NA	1.10E+02 N	NA	NA	NO	BSL
	7439-92-1	Lead	7.05E-06	9.39E-04	µg/m3	IS11SS440001P	20/20	NA - Modeled	9.39E-04	NA	NA	NA	NA	NO	BSL
	7439-95-4	Magnesium	2.83E-04 J	1.81E-03	µg/m3	IS11SB490002	20/20	NA - Modeled	1.81E-03	NA	NA	NA	NA	NO	NUT
	7439-96-5	Manganese	4.19E-05	5.55E-04 L	µg/m3	IS11SS510001	20/20	NA - Modeled	5.55E-04	NA	5.22E-03 N	NA	NA	NO	BSL
	7439-97-6	Mercury	5.30E-08 J	3.11E-07	µg/m3	IS11SS510001	13/20	NA - Modeled	3.11E-07	NA	3.14E-02 N	NA	NA	NO	BSL
	7440-02-0	Nickel	4.02E-06 J	5.89E-05 J	µg/m3	IS11SS510001	20/20	NA - Modeled	5.89E-05	NA	7.30E+00 N	NA	NA	NO	BSL
	7440-09-7	Potassium	1.75E-04 J	6.02E-04 J	µg/m3	IS11SS480001	20/20	NA - Modeled	6.02E-04	NA	NA	NA	NA	NO	NUT
	7782-49-2	Selenium	6.52E-07 J	4.32E-06	µg/m3	IS11SS510001	20/20	NA - Modeled	4.32E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-22-4	Silver	1.59E-07 J	7.88E-06	µg/m3	IS11SS440001P	15/20	NA - Modeled	7.88E-06	NA	1.83E+00 N	NA	NA	NO	BSL
	7440-23-5	Sodium	1.50E-04 J	2.60E-03	µg/m3	IS11SS480001	20/20	NA - Modeled	2.60E-03	NA	NA	NA	NA	NO	NUT
	7440-28-0	Thallium	3.94E-06 L	3.94E-06 L	µg/m3	IS11SS510001	1/6	NA - Modeled	3.94E-06	NA	2.56E-02 N	NA	NA	NO	BSL
	7440-62-2	Vanadium	1.29E-05	2.90E-05	µg/m3	IS11SB490002	20/20	NA - Modeled	2.90E-05	NA	3.65E-01 N	NA	NA	NO	BSL
	7440-66-6	Zinc	1.63E-05	1.51E-03 K	µg/m3	IS11SS480001	20/20	NA - Modeled	1.51E-03	NA	1.10E+02 N	NA	NA	NO	BSL

* Surface soil & subsurface soil combined

[1] Minimum/Maximum calculated air concentrations from soil concentrations. Air concentrations calculated as Cair = Csoil*1000*(1/PEF+1/VF)
VF only included in calculation for VOCs. VF calculated on Table 2.2A. PEF = 1.32E+09 m3/kg.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.
RBC value for pyrene used as surrogate for phenanthrene and benzo(g,h,i)perylene.
RBC value for naphthalene used as surrogate for acenaphthylene.
RBC value for Chromium VI used for total chromium.
The lead screening value is 400 mg/kg, the USEPA residential screening level.
RBC value for elemental mercury used as surrogate for mercury.

[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

SQL = Sample Quantification Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
L = Biased Low

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Area B, Site 11	71-55-6	1,1,1-Trichloroethane	1.50E+01	1.50E+01	µg/L	IS11MW070302	1/3	10 - 10	1.50E+01		3.17E+02 N	2.00E+02	MCL	NO	BSL
	75-35-4	1,1-Dichloroethene	9.00E+00 J	9.00E+00 J	µg/L	IS11MW070302	1/3	10 - 10	9.00E+00		3.53E+01 N	7.00E+00	MCL	NO	BSL
	67-64-1	Acetone	1.00E+01	1.10E+01	µg/L	IS11MW060302P	4/3	10 - 10	1.10E+01		5.48E+02 N	NA		NO	BSL
	71-43-2	Benzene	1.00E+00 J	1.00E+00 J	µg/L	IS11MW060302	1/3	10 - 10	1.00E+00		3.36E-01 C	5.00E+00		YES	ASL
	74-83-9	Bromomethane	2.00E+00 J	2.00E+00 J	µg/L	IS11MW060302P	1/3	10 - 10	2.00E+00		8.52E-01 N	NA		YES	ASL
	74-87-3	Chloromethane	2.00E+00 J	2.00E+00 J	µg/L	IS11MW060302 IS11MW080302	3/3	10 - 10	2.00E+00		1.90E+01 N	NA		NO	BSL
	110-82-7	Cyclohexane	6.00E-01 J	6.00E-01 J	µg/L	IS11MW060302P	1/3	10 - 10	6.00E-01		1.24E+03 N	NA		NO	BSL
	100-41-4	Ethylbenzene	4.00E-01 J	4.00E-01 J	µg/L	IS11MW060302P	1/3	10 - 10	4.00E-01		1.34E+02 N	7.00E+02	MCL	NO	BSL
	108-88-3	Toluene	4.00E-01 J	3.00E+00 J	µg/L	IS11MW060302 IS11MW060302P	3/3	10 - 10	3.00E+00		7.47E+01 N	1.00E+03	MCL	NO	BSL
	106-44-5	4-Methylphenol	8.00E-01 J	5.00E+00 J	µg/L	IS11MW070302	4/3	10 - 10	5.00E+00		1.83E+01 N	NA		NO	BSL
	83-32-9	Acenaphthene	4.00E-01 J	4.00E-01 J	µg/L	IS11MW060302	1/3	10 - 10	4.00E-01		3.65E+01 N	NA		NO	BSL
	98-86-2	Acetophenone	4.00E-01 J	4.00E-01 J	µg/L	IS11MW060302P	1/3	10 - 10	4.00E-01		6.08E+01 N	NA		NO	BSL
Total	7429-90-5	Aluminum	1.92E+02 J	1.35E+03	µg/L	IS11MW080302	4/3	200 - 200	1.35E+03		3.65E+03 N	NA		NO	BSL
	7440-36-0	Antimony	1.80E+00 J	2.90E+00	µg/L	IS11MW070302	2/3	60 - 60	2.90E+00		1.46E+00 N	6.00E+00	MCL	YES	ASL
	7440-38-2	Arsenic	2.90E+00 J	2.90E+00	µg/L	IS11MW060302	1/3	10 - 10	2.90E+00		4.46E-02 C	1.00E+01	MCL	YES	ASL
	7440-39-3	Barium	1.51E+02 J	1.78E+02	µg/L	IS11MW070302	3/3	200 - 200	1.78E+02		2.56E+02 N	2.00E+03	MCL	NO	BSL
	7440-41-7	Beryllium	5.10E-01 J	6.40E-01	µg/L	IS11MW060302	4/3	5 - 5	6.40E-01		7.30E+00 N	4.00E+00	MCL	NO	BSL
	7440-70-2	Calcium	5.12E+04 J	5.41E+04	µg/L	IS11MW070302	3/3	5000 - 5000	5.41E+04		NA	NA	NA	NO	NUT
	7440-47-3	Chromium	1.60E+00 J	7.90E+00	µg/L	IS11MW060302	3/3	10 - 10	7.90E+00		1.10E+01 N	1.00E+02	MCL	NO	BSL
	7440-50-8	Copper	2.60E+00 J	7.30E+00 J	µg/L	IS11MW060302	3/3	25 - 25	7.30E+00		1.46E+02 N	1.30E+03	MCL	NO	BSL
	7439-89-6	Iron	3.13E+04 J	4.47E+04 J	µg/L	IS11MW080302	4/3	100 - 100	4.47E+04		1.10E+03 N	NA	NA	YES	ASL
	7439-92-1	Lead	1.90E+00 J	3.28E+01	µg/L	IS11MW080302	4/3	3 - 3	3.28E+01		#N/A ##	1.50E+01	MCL	#N/A	#N/A
	7439-95-4	Magnesium	1.47E+04	2.70E+04	µg/L	IS11MW070302	4/3	5000 - 5000	2.70E+04		NA	NA	NA	NO	NUT
	7439-96-5	Manganese	1.45E+03	3.02E+03	µg/L	IS11MW080302	4/3	15 - 15	3.02E+03		7.30E+01 N	NA	NA	YES	ASL
	7440-02-0	Nickel	2.30E+00	6.40E+00	µg/L	IS11MW060302	3/3	40 - 40	6.40E+00		7.30E+01 N	NA	NA	NO	BSL
	7440-09-7	Potassium	4.22E+03	6.30E+03 J	µg/L	IS11MW080302	3/3	5000 - 5000	6.30E+03		NA	NA	NA	NO	NUT
	7782-49-2	Selenium	2.50E+00	2.90E+00 J	µg/L	IS11MW070302	2/3	5 - 5	2.90E+00		1.83E+01 N	5.00E+01	MCL	NO	BSL
	7440-22-4	Silver	6.80E-01 J	6.80E-01 J	µg/L	IS11MW080302	1/3	10 - 10	6.80E-01		1.83E+01 N	NA	NA	NO	BSL
	7440-23-5	Sodium	4.44E+04 J	7.11E+04 J	µg/L	IS11MW060302	3/3	5000 - 5000	7.11E+04		NA	NA	NA	NO	NUT
	7440-62-2	Vanadium	2.10E+00 J	3.60E+00 J	µg/L	IS11MW080302	4/3	50 - 50	3.60E+00		3.65E+00 N	NA	NA	NO	BSL
	7440-66-6	Zinc	1.57E+01 J	3.99E+01 J	µg/L	IS11MW080302	3/3	20 - 20	3.99E+01		1.10E+03 N	NA	NA	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

Table 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Area B, Site 11

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection

[4] Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.
RBC value for Chromium VI used for total chromium.
Screening value for lead is the MCL
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

MCL = Maximum contaminant level for drinking water (USEPA, 2004)
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic

Table 3.1.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Area B, Site 11											
	Benzo(a)pyrene	mg/kg	2.10E-01	2.85E-01	(N)	4.60E-01	J	2.85E-01	mg/kg	95% Stud-t	(2)
	Dibenz(a,h)anthracene	mg/kg	1.20E-01	1.66E-01	(N)	1.70E-01	J	1.66E-01	mg/kg	95% Stud-t	(2)
	Aluminum	mg/kg	9.85E+03	1.27E+04	(NP)	2.34E+04		1.27E+04	mg/kg	95% Stud-t	(5)
	Antimony	mg/kg	2.09E+00	4.76E+00	(G)	9.50E+00	L	4.76E+00	mg/kg	App. Gamma	(1, 3, 4)
	Arsenic	mg/kg	1.16E+01	1.70E+01	(N)	2.55E+01		1.70E+01	mg/kg	95% Stud-t	(2)
	Cadmium	mg/kg	6.52E+00	2.23E+01	(NP)	2.04E+01		2.04E+01	mg/kg	Max	(6)
	Chromium	mg/kg	3.48E+01	8.89E+01	(NP)	1.51E+02	J	8.89E+01	mg/kg	95% Cheb-m	(5)
	Copper	mg/kg	2.82E+02	7.37E+02	(G)	1.38E+03	K	7.37E+02	mg/kg	App. Gamma	(1, 3, 4)
	Iron	mg/kg	3.46E+04	7.89E+04	(NP)	1.30E+05		7.89E+04	mg/kg	95% Cheb-m	(5)
	Lead	mg/kg	3.62E+02	8.73E+02	(NP)	1.24E+03		3.62E+02	mg/kg	Mean-N	(7)
	Manganese	mg/kg	3.56E+02	4.95E+02	(N)	7.33E+02	L	4.95E+02	mg/kg	95% Stud-t	(2)
	Thallium	mg/kg	1.22E+00	9.15E+00	(NP)	5.20E+00	L	5.20E+00	mg/kg	Max	(6)
	Vanadium	mg/kg	2.46E+01	2.63E+01	(N)	3.02E+01		2.63E+01	mg/kg	95% Stud-t	(2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 3.00.02 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb);
99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m);
99% Chebyshev (mean,std) UCL (99% Cheb-m); 95% modified-t UCL adjusted for skewness (95% Mod-t); 95% Student's-T test UCL (95% Stud-t);
95% Hall's Bootdtrap UCL (95% Hall); 95% Approximate Gamma (App. Gamma); 95% Adjusted Gamma (Adj. Gamma);
Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T)

Table 3.1.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Anderson-Darling Test indicates data are gamma distributed.

(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.

(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).

(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the Max.

(7) Mean value to be used for lead modeling.

mg/kg = milligrams per kilogram

G = Gamma distribution.

N = Normal distribution.

T = Log-normal distribution.

NP = Non-Parametric distribution.

Table 3.2.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Area B, Site 11											
	Benzo(a)anthracene	mg/kg	2.48E-01	4.12E-01	(T)	1.40E+00		4.12E-01	mg/kg	95% UCL-T	(1)
	Benzo(a)pyrene	mg/kg	2.33E-01	3.26E-01	(G)	1.10E+00		3.26E-01	mg/kg	App. Gamma	(1, 3, 4)
	Benzo(b)fluoranthene	mg/kg	2.88E-01	4.24E-01	(G)	1.50E+00		4.24E-01	mg/kg	App. Gamma	(1, 3)
	Dibenz(a,h)anthracene	mg/kg	1.36E-01	2.28E-01	(NP)	3.60E-01	J	2.28E-01	mg/kg	95% Cheb-m	(5)
	Aluminum	mg/kg	9.20E+03	1.09E+04	(G)	2.34E+04		1.09E+04	mg/kg	App. Gamma	(1, 3)
	Antimony	mg/kg	1.86E+00	7.30E+00	(NP)	9.50E+00	L	7.30E+00	mg/kg	99% Cheb-m	(5)
	Arsenic	mg/kg	1.02E+01	1.54E+01	(G)	2.55E+01		1.54E+01	mg/kg	App. Gamma	(3,4)
	Cadmium	mg/kg	4.88E+00	1.07E+01	(G)	2.04E+01		1.07E+01	mg/kg	Adj. Gamma	(4)
	Chromium	mg/kg	2.76E+01	5.86E+01	(NP)	1.51E+02	J	5.86E+01	mg/kg	95% Cheb-m	(5)
	Copper	mg/kg	2.30E+02	4.67E+02	(G)	1.38E+03	K	4.67E+02	mg/kg	Adj. Gamma	(4)
	Iron	mg/kg	2.62E+04	3.42E+04	(T)	1.30E+05		3.42E+04	mg/kg	95% UCL-T	(1)
	Lead	mg/kg	3.21E+02	5.85E+02	(G)	1.24E+03		3.21E+02	mg/kg	Mean-N	(7)
	Manganese	mg/kg	2.81E+02	3.92E+02	(G)	7.33E+02	L	3.92E+02	mg/kg	App. Gamma	(1, 3, 4)
	Thallium	mg/kg	1.22E+00	9.15E+00	(NP)	5.20E+00	L	5.20E+00	mg/kg	Max	(6)
	Vanadium	mg/kg	2.41E+01	2.60E+01	(N)	3.83E+01		2.60E+01	mg/kg	95% Std-t	(2)

* Surface soil & subsurface soil combined.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

ProUCL, Version 3.00.02 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb);
99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m);
99% Chebyshev (mean,std) UCL (99% Cheb-m); 95% modified-t UCL adjusted for skewness (95% Mod-t); 95% Student's-T test UCL (95% Stud-t);
95% Hall's Bootdtrap UCL (95% Hall); 95% Approximate Gamma (App. Gamma); 95% Adjusted Gamma (Adj. Gamma);
Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T)

Table 3.2.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test indicates data are normally distributed.

(3) Anderson-Darling Test indicates data are gamma distributed.

(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.

(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).

(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the Max.

(7) Mean value to be used for lead modeling.

mg/kg = milligrams per kilogram

G = Gamma distribution.

N = Normal distribution.

T = Log-normal distribution.

NP = Non-Parametric distribution.

Table 3.3.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Area B, Site 11										
	Benzene	µg/L	3.67E+00	7.56E+00	1.00E+00	J	1.00E+00	µg/L	Max	(1)
	Bromomethane	µg/L	4.00E+00	6.92E+00	2.00E+00	J	2.00E+00	µg/L	Max	(1)
TOTAL	Antimony	µg/L	1.82E+00	3.63E+00	2.90E+00		2.90E+00	µg/L	Max	(1)
	Arsenic	µg/L	1.53E+00	3.53E+00	2.90E+00		2.90E+00	µg/L	Max	(1)
	Iron	µg/L	3.94E+04	5.13E+04	4.47E+04	J	4.47E+04	µg/L	Max	(1)
	Lead	µg/L	1.45E+01	4.18E+01	3.28E+01		3.28E+01	µg/L	Max	(1)
	Manganese	µg/L	2.36E+03	3.73E+03	3.02E+03		3.02E+03	µg/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Max = Maximum Detected Value

(1) Maximum detected concentration used because sample size is less than 5.

Table 3.1.CTE

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Area B, Site 11											
	Benzo(a)pyrene	mg/kg	2.10E-01	2.85E-01	(N)	4.60E-01	J	2.10E-01	mg/kg	Mean-N	(2)
	Dibenz(a,h)anthracene	mg/kg	1.20E-01	1.66E-01	(N)	1.70E-01	J	1.20E-01	mg/kg	Mean-N	(2)
	Aluminum	mg/kg	9.85E+03	1.27E+04	(NP)	2.34E+04		9.85E+03	mg/kg	Mean-N	(5)
	Antimony	mg/kg	2.09E+00	4.76E+00	(G)	9.50E+00	L	2.09E+00	mg/kg	Mean-N	(1, 3, 4)
	Arsenic	mg/kg	1.16E+01	1.70E+01	(N)	2.55E+01		1.16E+01	mg/kg	Mean-N	(2)
	Cadmium	mg/kg	6.52E+00	2.23E+01	(NP)	2.04E+01		6.52E+00	mg/kg	Mean-N	(5)
	Chromium	mg/kg	3.48E+01	8.89E+01	(NP)	1.51E+02	J	3.48E+01	mg/kg	Mean-N	(5)
	Copper	mg/kg	2.82E+02	7.37E+02	(G)	1.38E+03	K	2.82E+02	mg/kg	Mean-N	(1, 3, 4)
	Iron	mg/kg	3.46E+04	7.89E+04	(NP)	1.30E+05		3.46E+04	mg/kg	Mean-N	(5)
	Lead	mg/kg	3.62E+02	8.73E+02	(NP)	1.24E+03		3.62E+02	mg/kg	Mean-N	(7)
	Manganese	mg/kg	3.56E+02	4.95E+02	(N)	7.33E+02	L	3.56E+02	mg/kg	Mean-N	(2)
	Thallium	mg/kg	1.22E+00	9.15E+00	(NP)	5.20E+00	L	1.22E+00	mg/kg	Mean-N	(5)
	Vanadium	mg/kg	2.46E+01	2.63E+01	(N)	3.02E+01		2.46E+01	mg/kg	Mean-N	(2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Statistics: Maximum Detected Value (Max); Mean of data assuming normal distribution (Mean-N);

Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed; use MVUE-mean.

(2) Shapiro-Wilks W Test indicates data are normally distributed; use mean based on normal distribution.

(3) Anderson-Darling Test indicates data are gamma distributed; use mean based on normal distribution.

(4) Kolmogorov-Smirnov Test indicates data are gamma distributed; use mean based on normal distribution.

(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed); use mean based on normal distribution.

Table 3.1.CTE

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Area B, Site 11

(6) The maximum detected concentration was used as the EPC since the mean is greater than the maximum detected concentration.

mg/kg = Milligrams per kilogram.

G = Gamma distribution.

N = Normal distribution.

T = Log-normal distribution.

NP = Non-Parametric distribution.

Table 3.2.CTE

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Area B, Site 11											
	Benzo(a)anthracene	mg/kg	2.48E-01	4.12E-01	(T)	1.40E+00		2.42E-01	mg/kg	Mean-T	(1)
	Benzo(a)pyrene	mg/kg	2.33E-01	3.26E-01	(G)	1.10E+00		2.33E-01	mg/kg	Mean-N	(1, 3, 4)
	Benzo(b)fluoranthene	mg/kg	2.88E-01	4.24E-01	(G)	1.50E+00		2.88E-01	mg/kg	Mean-N	(1, 3)
	Dibenz(a,h)anthracene	mg/kg	1.36E-01	2.28E-01	(NP)	3.60E-01	J	1.36E-01	mg/kg	Mean-N	(5)
	Aluminum	mg/kg	9.20E+03	1.09E+04	(G)	2.34E+04		9.20E+03	mg/kg	Mean-N	(1, 3)
	Antimony	mg/kg	1.86E+00	7.30E+00	(NP)	9.50E+00	L	1.86E+00	mg/kg	Mean-N	(5)
	Arsenic	mg/kg	1.02E+01	1.54E+01	(G)	2.55E+01		1.02E+01	mg/kg	Mean-N	(3,4)
	Cadmium	mg/kg	4.88E+00	1.07E+01	(G)	2.04E+01		4.88E+00	mg/kg	Mean-N	(4)
	Chromium	mg/kg	2.76E+01	5.86E+01	(NP)	1.51E+02	J	2.76E+01	mg/kg	Mean-N	(5)
	Copper	mg/kg	2.30E+02	4.67E+02	(G)	1.38E+03	K	2.30E+02	mg/kg	Mean-N	(4)
	Iron	mg/kg	2.62E+04	3.42E+04	(T)	1.30E+05		2.48E+04	mg/kg	Mean-T	(1)
	Lead	mg/kg	3.21E+02	5.85E+02	(G)	1.24E+03		3.21E+02	mg/kg	Mean-N	(7)
	Manganese	mg/kg	2.81E+02	3.92E+02	(G)	7.33E+02	L	2.81E+02	mg/kg	Mean-N	(1, 3, 4)
	Thallium	mg/kg	1.22E+00	9.15E+00	(NP)	5.20E+00	L	1.22E+00	mg/kg	Mean-N	(5)
	Vanadium	mg/kg	2.41E+01	2.60E+01	(N)	3.83E+01		2.41E+01	mg/kg	Mean-N	(2)

* Surface soil & subsurface soil combined.

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Statistics: Maximum Detected Value (Max); Mean of data assuming normal distribution (Mean-N);

Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed; use MVUE-mean.

(2) Shapiro-Wilks W Test indicates data are normally distributed; use mean based on normal distribution.

(3) Anderson-Darling Test indicates data are gamma distributed; use mean based on normal distribution.

(4) Kolmogorov-Smirnov Test indicates data are gamma distributed; use mean based on normal distribution.

Table 3.2.CTE
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Area B, Site 11

(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed); use mean based on normal distribution.

(6) The maximum detected concentration was used as the EPC since the mean is greater than the maximum detected concentration.

mg/kg = Milligrams per kilogram.

G = Gamma distribution.

N = Normal distribution.

T = Log-normal distribution.

NP = Non-Parametric distribution.

Table 3.3.CTE
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Area B, Site 11

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of (N/T)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Area B, Site 11										
	Benzene	µg/L	3.67E+00	7.56E+00	1.00E+00	J	1.00E+00	µg/L	Max	(1)
	Bromomethane	µg/L	4.00E+00	6.92E+00	2.00E+00	J	2.00E+00	µg/L	Max	(1)
TOTAL	Antimony	µg/L	1.82E+00	3.63E+00	2.90E+00		1.82E+00	µg/L	Mean-N	(2)
	Arsenic	µg/L	1.53E+00	3.53E+00	2.90E+00		1.53E+00	µg/L	Mean-N	(2)
	Iron	µg/L	3.94E+04	5.13E+04	4.47E+04	J	3.94E+04	µg/L	Mean-N	(2)
	Lead	µg/L	1.45E+01	4.18E+01	3.28E+01		1.45E+01	µg/L	Mean-N	(2)
	Manganese	µg/L	2.36E+03	3.73E+03	3.02E+03		2.36E+03	µg/L	Mean-N	(2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Max = Maximum Detected Value; Mean-N = Mean based on normally distributed dataset.

(1) Maximum detected concentration used because sample size is less than 5 and mean is greater than the max detect due to detection limits.
(2) The mean based on normal distribution was used at the EPC.

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser/Visitor	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997,(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004 (4)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004 (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem. specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	4,000	cm^2	EPA, 2004 (6)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm^2-day	EPA, 2004 (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem. specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	51	kg	EPA, 1997,(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004 (8)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004 (9)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

Notes:

(1) Professional Judgment assuming 1 day per week for 52 weeks per year.

(2) Professional Judgment assuming adolescents from 9 to 18 years of age.

(3) Body weight is average value for the 9 year old and 18 year old male body weight.

(4) Skin surface area is for an adult resident.

(5) Soil to skin adherence factor is based on geometric mean for residential gardeners.

(6) Skin surface area is for a teen ages 9 to 18 years of age, accounting for average between males and females for face, forearms, hands. and lower legs.

(7) Soil to skin adherence factor is based on geometric mean for rugby players.

(8) Skin surface area is for an adult commercial/industrial worker.

(9) Soil to skin adherence factor is the recommended value for an adult commercial/industrial worker.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	480	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident	Adult	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion (continued)	Resident	Child	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 1991	CS x IR-S-Adj x EF x CF3 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 1991	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	114.29	mg-year/kg-day	calculated	IR-S-Adj (mg-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Construction Worker	Adult	Area B, Site 11 Soil*	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004, (2)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004, (3)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		CDI (mg/kg-day) =
			Soil*	SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004, (2)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004, (3)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		CDI (mg/kg-day) =
			Soil*	SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004, (4)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		CDI (mg/kg-day) =
			Soil*	SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2004, (6)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004, (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.2.RME	mg/kg		CDI (mg/kg-day) =
			Soil*	SA-A	Skin Surface Area Available for Contact, Ad	5,700	cm^2	EPA, 2004	CS x DA-Adj x DABS x CF3 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Ch	2,800	cm^2	EPA, 2004	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm^2-day	EPA, 2004	DA-Adj (mg-year/kd-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm^2-day	EPA, 2004	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A x SSAF-A / BW-A)]
				DA-Adj	Dermal Absorption, Age-adjusted	361	mg-year/kg-day	calculated	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

Soil* = Combined surface and subsurface soil.

(1) Assumed duration of construction project may be 1/2 a year.

(2) Surface area based on adult worker wearing long pants, short-sleeved shirt, and shoes.

(3) Soil to skin adherence factor is based on 50th percentile weighted adherence factor for utility workers.

(4) Surface area based on adult resident wearing shorts, short-sleeved shirt, and shoes.

(5) Soil to skin adherence factor is geometric mean of weighted soil adherence factor for residential gardners.

(6) Surface area based on child resident wearing shorts and short-sleeved shirt (no shoes).

(7) Soil to skin adherence factor is based 95th percentile weighted soil adherence factor for children playing at a day care center, or 50th percentile for children playing in wet soil.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l		CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l		CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	1.00	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Resident	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	CDI (mg/kg-day) = DA-Adj x EFx EV x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	$((1 + 3B + 3B^2)/(1+B)^2)$) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Construction Worker	Adult	Upper Aquifer-Excavation Pit	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	8	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,000	cm^2	EPA, 2004, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	(1)	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) Professional Judgment based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be 30 percent of total surface area (hands, forearms, lower legs, and feet).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Upper Aquifer-Water Vapors at showerhead	CW	Chemical Concentration in Water	See Table 3.2.RME	µg/l		Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV xED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2001	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Construction Worker	Adult	Upper Aquifer-Water Vapors at Excavation Pit	CW	Chemical Concentration in Water	See Table 3.2.RME	µg/l		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1991	
				ET	Exposure Time	8	hr/day	(1)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Professional Judgment based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser/Visitor	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997,(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
			Surface Soil	IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser/Visitor	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004 (4)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004 (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem. specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Trespasser/Visitor	Adolescent	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	4,000	cm^2	EPA, 2004 (6)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm^2-day	EPA, 2004 (7)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem. specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	51	kg	EPA, 1997,(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CTE	mg/kg		CDI (mg/kg-day) =
			Surface Soil	SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004 (8)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004 (9)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	EPA, 1989	

Notes:

(1) Professional Judgment assuming 1/2 the RME value.

(2) Professional Judgment assuming adolescents from 9 to 18 years of age.

(3) Body weight is average value for the 9 year old and 18 year old male body weight.

(4) Skin surface area is for an adult resident.

(5) Soil to skin adherence factor is based on geometric mean for residential gardeners.

(6) Skin surface area is for a teen ages 9 to 18 years of age, accounting for average between males and females for face, forearms, hands. and lower legs.

(7) Soil to skin adherence factor is based on geometric mean for rugby players.

(8) Skin surface area is for an adult commercial/industrial worker.

(9) Soil to skin adherence factor is the recommended value for an adult commercial/industrial worker.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	(2)	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,409	days	- -	
	Resident	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	50	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Child	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	50	mg/day	EPA, 1993	CS x IR-S-Adj x EF x CF3 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	100	mg/day	EPA, 1993	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	46.43	mg-year/kg-day	calculated	IR-S-Adj (mg-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Construction Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1992, (3)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Industrial Worker	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1992, (3)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (4)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	219	days/year	EPA, 1993	
				ED	Exposure Duration	6.6	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	- -	
	Resident	Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001, (5)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2001, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Child	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2001, (7)	CS x SA x SSAF x DABS x CF3 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (8)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Area B, Site 11	CS	Chemical Concentration in Soil	see Table 3.1.CT	mg/kg		CDI (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Ad	5,700	cm^2	EPA, 2001	CS x DA-Adj x DABS x CF3 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Ch	2,800	cm^2	EPA, 2001	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm^2-day	EPA, 2001	DA-Adj (mg-year/kd-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm^2-day	EPA, 2001	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A x SSAF-A / BW-A)]
				DA-Adj	Dermal Absorption, Age-adjusted	275.3	mg-year/kg-day	calculated	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 1995	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Assumed duration of construction project may be 1/2 a year.

(2) Recommendation from EPA Region III Risk Assessor.

(3) Surface area includes head and hands.

(4) Soil to skin adherence factor is based on 50th percentile weighted adherence factor for utility workers.

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

(5) Surface area based on adult resident wearing shorts, short-sleeved shirt, and shoes.

(6) Soil to skin adherence factor is geometric mean of weighted soil adherence factor for residential gardners.

(7) Surface area based on child resident wearing shorts and short-sleeved shirt (no shoes).

(8) Soil to skin adherence factor is based 95th percentile weighted soil adherence factor for children playing at a day care center, or 50th percentile for children playing in wet soil.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.33	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Upper Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) = DA-Adj x EF x EV x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Construction Worker	Adult	Upper Aquifer-Excavation Pit	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l	See Table 3.2.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	4	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,000	cm^2	EPA, 1997, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	(1)	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) Professional judgment assuming 1/2 RME value for CT.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be 30 percent of total surface area (hands, forearms, lower legs, and feet).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Upper Aquifer-Water Vapors at showerhead	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l		Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x EV x ED x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 1993	for InhExp
				EV	Event Frequency	1	events/day	EPA, 2001	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Construction Worker	Adult	Upper Aquifer-Water Vapors at Excavation Pit	CW	Chemical Concentration in Water	See Table 3.2.CT	µg/l		Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1991	
				ET	Exposure Time	4	hr/day	(1)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Professional Judgment assuming 1/2 the RME value for the CT.

(2) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	Neurological	100	PPRTV	06/22/04
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000/1	IRIS	06/13/05
	Subchronic	2.0E-04	mg/kg-day	15%	3.0E-05	mg/kg-day	Blood	300	PPRTV	06/22/04
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin,vascular	3/1	IRIS	06/13/05
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin,vascular	3	HEAST	07/01/97
Benzene	Chronic	4.0E-03	mg/kg/day	NA	4.0E-03	mg/kg/day	Blood, Immune	300/1	IRIS	06/13/05
	Subchronic	3.0E-03	mg/kg/day	NA	3.0E-03	mg/kg/day	Blood	3000	NCEA	07/08/98
Benzo(a)anthracene	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Benzo(a)pyrene	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Benzo(b)fluoranthene	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Bromomethane	Chronic	1.4E-03	mg/kg/day	NA	1.4E-03	mg/kg/day	Gastrointestinal	1000/1	IRIS	06/10/05
	Subchronic	NA	NA	NA	NA	mg/kg/day	NA	NA	NA	07/08/98
Cadmium (food)	Chronic	1.0E-03	mg/kg-day	2.5%	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	06/13/05
(for soil)	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	Not identified	300/3	IRIS	06/13/05
	Subchronic	2.0E-02	mg/kg-day	2.5%	5.0E-04	mg/kg-day	Not identified	100	HEAST	07/01/97
Copper	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day	Gastrointestinal	NA	HEAST	07/01/97
	Subchronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day	Gastrointestinal		HEAST	07/01/97
Dibenzo(a,h)anthracene	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Iron	Chronic	3.0E-01	mg/kg/day	NA	3.0E-01	mg/kg/day	Gastrointestinal, Blood, Liver	1	NCEA	01/05/99
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	12/30/03
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Manganese (nonfood)	Chronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	CNS	1/1	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Manganese (food)	Chronic	1.4E-01	mg/kg-day	4%	5.6E-03	mg/kg-day	CNS	1/1	IRIS	06/13/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Thallium	Chronic	7.0E-05	mg/kg-day	NA	7.0E-05	mg/kg-day	Liver, Blood, Hair	NA	RBC	04/07/05
	Subchronic	NA	mg/kg-day	NA	NA	mg/kg-day	NA	NA	NA	NA
Vanadium	Chronic	1.0E-03	mg/kg-day	2.6%	2.6E-05	mg/kg-day	Kidney	300	NCEA	05/01/00
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Lifetime	100	HEAST	07/01/97

NA = Not Applicable or Not Available.

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemetnal Guidance for Dermal Risk Assessment. Final.

Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)

Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

ATSDR = Agency for Toxic Substances and Disease Registry

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer-Reviewed Toxicity Value

RESP = Respiratory System

CNS = Central Nervous System

NOAEL = No adverse effect level

(2) Provide equation for derivation in text.

PPRTV = Provisional Peer-Reviewed Toxicity Value

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

Table 5.2
NON-CANCER TOXICITY DATA -- INHALATION
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ (2)	Dates (3) (MM/DD/YY)
Aluminum	Chronic	5.00E-03	mg/m^3	1.43E-03	mg/kg-day	Neurological	300	PPRTV	06/22/04
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Antimony	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	4.00E-04	mg/m3	1E-04	mg/kg-day	Lungs	1E+02	PPRTV	06/22/04
Arsenic	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Benzene	Chronic	3.01E-02	mg/m3	8.6E-03	mg/kg-day	Blood, Immune	300/1	IRIS	06/13/05
	Subchronic	6.0E-02	mg/m3	1.7E-02	mg/kg-day	Blood	100	NCEA	07/02/96
Benzo(a)anthracene	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Benzo(a)pyrene	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Benzo(b)fluoranthene	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Bromomethane	Chronic	5E-03	mg/m^3	1.40E-03	mg/kg-day	Nasal Mucosa	100/1	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Cadmium (food)	Chronic	2.00E-04	mg/m3	5.7E-05	mg/kg-day	Kidney	NA	NCEA	12/29/03
	Subchronic	9.00E-04	mg/m3	2.6E-04	mg/kg-day	Kidney	NA	NCEA	
Chromium (hexavalent)	Chronic	1.00E-04	mg/m^3	2.86E-05	mg/kg-day	Respiratory System	300/1	IRIS	06/13/05
	Subchronic	4.00E-06	mg/m^3	1.14E-06	mg/kg-day	Respiratory System	100	NCEA	05/14/93
Copper	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Lead	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Manganese	Chronic	5.01E-05	mg/m^3	1.43E-05	mg/kg-day	CNS	1000/1	IRIS	06/13/05
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	Chronic	NA	mg/m^3	NA	mg/kg-day	NA	NA	IRIS	06/13/05
	Subchronic	NA	mg/m3	NA	mg/kg-day	NA	NA	NA	NA
Vanadium	Chronic	NA	NA	NA	NA	NA	NA	IRIS	06/13/05
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not Applicable
(1) Provide equation used for derivation in text.
(2) HEAST, Alternative Methods used as source of barium values.
Chromium and cadmium values were withdrawn from HEAST, but available in Region III RBC Table.
(3) For IRIS values, provide the date IRIS was searched.

ATSDR = Agency for Toxic Substances and Disease Registry
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
HEAST Table 2 = Health Effects Assessment Summary Tables, Alternate Methods
HEAST Table 3 = Health Effects Assessment Summary Tables, Carcinogenicity

Table 5.2
NON-CANCER TOXICITY DATA -- INHALATION
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ (2)	Dates (3) (MM/DD/YY)

For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

HEAST(4)= Health Effects Assessment Summary Tables, Withdrawn
NCEA = National Center for Environmental Assessment

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)
Aluminum	NA	NA	NA	NA	NA	NCEA	8/26/1996
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	6/13/2005
Benzene	5.5E-02	NA	5.5E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	6/13/2005
Benzo(a)anthracene	7.3E-01	58%-89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Benzo(a)pyrene	7.3E+00	58%-89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	6/13/2005
Benzo(b)fluoranthene	7.3E-01	58%-89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Bromomethane	NA	NA	NA	NA	D	IRIS	06/10/05
Cadmium-Food	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	NA	NA	NA	NA	D	IRIS	06/10/05
Copper	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	7.3E+00	58%-89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Iron	NA	NA	NA	NA	NA	NCEA	7/23/1996
Lead	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	NA	NA	D	IRIS	06/10/05
Thallium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	IRIS	6/13/2005

N/A-Not available

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer-Reviewed Toxicity Value

EPA Carcinogen Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

(1) Refer to RAGS, Part E. July 2004.

(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide article date provided by NCEA.
For RBC values, provide the date of last change in the Tables.

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (2) (MM/DD/YY)
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.0E-03	$(ug/m3)^{-1}$	3500	1.5E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	6/13/2005
Benzene	8.2E-06	$(ug/m3)^{-1}$	3500	2.9E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	6/13/2005
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	8.9E-04	$(ug/m3)^{-1}$	3500	3.1E+00	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	11/18/1994
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	D	IRIS	6/13/2005
Cadmium	1.8E-03	$(ug/m3)^{-1}$	3500	6.3E+00	$(mg/kg\text{-}day)^{-1}$	B1	IRIS	6/13/2005
Chromium (hexavalent)	1.2E-02	$(ug/m3)^{-1}$	3500	4.1E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	6/13/2005
Copper	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NCEA	7/23/1996
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D	IRIS	6/13/2005
Thallium	NA	NA	NA	NA	NA	NA	RBC	4/7/2005
Vanadium	NA	NA	NA	NA	NA	D	IRIS	06/13/05

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer-Reviewed Toxicity Value

NA = Not Available

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor =
70kg x 1/20m3/day x 1000ug/mg

(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.
For RBC values, provide the date of last change in the Tables.

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer Intake/Exposure Concentration Value	Cancer Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk	Non-Cancer Intake/Exposure Concentration Value	Non-Cancer Intake/Exposure Concentration Units	RfD/RfC Value	RfD/RfC Units	Hazard Quotient
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Ingestion	Benzo(a)pyrene	2.8E-01	mg/kg	1.0E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.5E-08	8.0E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	6.0E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.4E-08	4.6E-08	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	4.6E-04	mg/kg/day	NA	NA	NA	3.5E-03	mg/kg/day	1.0E+00	mg/kg/day	3.5E-03
				Antimony	4.8E+00	mg/kg	1.7E-07	mg/kg/day	NA	NA	NA	1.3E-06	mg/kg/day	4.0E-04	mg/kg/day	3.3E-03
				Arsenic	1.7E+01	mg/kg	6.1E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	9.1E-07	4.7E-06	mg/kg/day	3.0E-04	mg/kg/day	1.6E-02
				Cadmium	2.0E+01	mg/kg	7.3E-07	mg/kg/day	NA	NA	NA	5.7E-06	mg/kg/day	1.0E-03	mg/kg/day	5.7E-03
				Chromium	8.9E+01	mg/kg	3.2E-06	mg/kg/day	NA	NA	NA	2.5E-05	mg/kg/day	3.0E-03	mg/kg/day	8.3E-03
				Copper	7.4E+02	mg/kg	2.6E-05	mg/kg/day	NA	NA	NA	2.1E-04	mg/kg/day	4.0E-02	mg/kg/day	5.1E-03
				Iron	7.9E+04	mg/kg	2.8E-03	mg/kg/day	NA	NA	NA	2.2E-02	mg/kg/day	3.0E-01	mg/kg/day	7.3E-02
				Manganese	4.9E+02	mg/kg	1.8E-05	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	6.9E-03
				Thallium	5.2E+00	mg/kg	1.9E-07	mg/kg/day	NA	NA	NA	1.5E-06	mg/kg/day	7.0E-05	mg/kg/day	2.1E-02
				Vanadium	2.6E+01	mg/kg	9.5E-07	mg/kg/day	NA	NA	NA	7.4E-06	mg/kg/day	1.0E-03	mg/kg/day	7.4E-03
			Exp. Route Total								1.0E-06					1.5E-01
			Dermal Absorption	Benzo(a)pyrene	2.8E-01	mg/kg	5.3E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.9E-08	4.1E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	3.1E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.3E-08	2.4E-08	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	1.8E-05	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	1.0E+00	mg/kg/day	1.4E-04
				Antimony	4.8E+00	mg/kg	6.8E-09	mg/kg/day	NA	NA	NA	5.3E-08	mg/kg/day	6.0E-05	mg/kg/day	8.9E-04
				Arsenic	1.7E+01	mg/kg	7.3E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.1E-07	5.7E-07	mg/kg/day	3.0E-04	mg/kg/day	1.9E-03
				Cadmium	2.0E+01	mg/kg	2.9E-09	mg/kg/day	NA	NA	NA	2.3E-08	mg/kg/day	2.5E-05	mg/kg/day	9.1E-04
				Chromium	8.9E+01	mg/kg	1.3E-07	mg/kg/day	NA	NA	NA	9.9E-07	mg/kg/day	7.5E-05	mg/kg/day	1.3E-02
				Copper	7.4E+02	mg/kg	1.1E-06	mg/kg/day	NA	NA	NA	8.2E-06	mg/kg/day	4.0E-02	mg/kg/day	2.1E-04
				Iron	7.9E+04	mg/kg	1.1E-04	mg/kg/day	NA	NA	NA	8.8E-04	mg/kg/day	3.0E-01	mg/kg/day	2.9E-03
				Manganese	4.9E+02	mg/kg	7.1E-07	mg/kg/day	NA	NA	NA	5.5E-06	mg/kg/day	8.0E-04	mg/kg/day	6.9E-03
				Thallium	5.2E+00	mg/kg	7.5E-09	mg/kg/day	NA	NA	NA	5.8E-08	mg/kg/day	7.0E-05	mg/kg/day	8.3E-04
				Vanadium	2.6E+01	mg/kg	3.8E-08	mg/kg/day	NA	NA	NA	2.9E-07	mg/kg/day	2.6E-05	mg/kg/day	1.1E-02
			Exp. Route Total								1.7E-07					3.9E-02
		Exposure Point Total									1.2E-06					1.9E-01
	Exposure Medium Total										1.2E-06					1.9E-01
Surface Soil Total											1.2E-06					1.9E-01
							Total of Receptor Risks Across All Media				1.2E-06	Total of Receptor Hazards Across All Media				1.9E-01

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer Intake/Exposure Concentration Value	Cancer Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk	Non-Cancer Intake/Exposure Concentration Value	Non-Cancer Intake/Exposure Concentration Units	RfD/RfC Value	RfD/RfC Units	Hazard Quotient
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Ingestion	Benzo(a)pyrene	2.8E-01	mg/kg	2.0E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.5E-07	5.8E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	1.2E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	8.5E-08	3.4E-08	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	8.8E-04	mg/kg/day	NA	NA	NA	2.6E-03	mg/kg/day	1.0E+00	mg/kg/day	2.6E-03
				Antimony	4.8E+00	mg/kg	3.3E-07	mg/kg/day	NA	NA	NA	9.7E-07	mg/kg/day	4.0E-04	mg/kg/day	2.4E-03
				Arsenic	1.7E+01	mg/kg	1.2E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.8E-06	3.5E-06	mg/kg/day	3.0E-04	mg/kg/day	1.2E-02
				Cadmium	2.0E+01	mg/kg	1.4E-06	mg/kg/day	NA	NA	NA	4.2E-06	mg/kg/day	1.0E-03	mg/kg/day	4.2E-03
				Chromium	8.9E+01	mg/kg	6.2E-06	mg/kg/day	NA	NA	NA	1.8E-05	mg/kg/day	3.0E-03	mg/kg/day	6.0E-03
				Copper	7.4E+02	mg/kg	5.1E-05	mg/kg/day	NA	NA	NA	1.5E-04	mg/kg/day	4.0E-02	mg/kg/day	3.7E-03
				Iron	7.9E+04	mg/kg	5.5E-03	mg/kg/day	NA	NA	NA	1.6E-02	mg/kg/day	3.0E-01	mg/kg/day	5.4E-02
				Manganese	4.9E+02	mg/kg	3.5E-05	mg/kg/day	NA	NA	NA	1.0E-04	mg/kg/day	2.0E-02	mg/kg/day	5.0E-03
				Thallium	5.2E+00	mg/kg	3.6E-07	mg/kg/day	NA	NA	NA	1.1E-06	mg/kg/day	7.0E-05	mg/kg/day	1.5E-02
				Vanadium	2.6E+01	mg/kg	1.8E-06	mg/kg/day	NA	NA	NA	5.4E-06	mg/kg/day	1.0E-03	mg/kg/day	5.4E-03
			Exp. Route Total								2.0E-06					1.1E-01
			Dermal Absorption	Benzo(a)pyrene	2.8E-01	mg/kg	1.0E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.5E-08	3.0E-08	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	6.0E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.4E-08	1.8E-08	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	3.5E-05	mg/kg/day	NA	NA	NA	1.0E-04	mg/kg/day	1.0E+00	mg/kg/day	1.0E-04
				Antimony	4.8E+00	mg/kg	1.3E-08	mg/kg/day	NA	NA	NA	3.9E-08	mg/kg/day	6.0E-05	mg/kg/day	6.4E-04
				Arsenic	1.7E+01	mg/kg	1.4E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	2.1E-07	4.1E-07	mg/kg/day	3.0E-04	mg/kg/day	1.4E-03
				Cadmium	2.0E+01	mg/kg	5.7E-09	mg/kg/day	NA	NA	NA	1.7E-08	mg/kg/day	2.5E-05	mg/kg/day	6.6E-04
				Chromium	8.9E+01	mg/kg	2.5E-07	mg/kg/day	NA	NA	NA	7.2E-07	mg/kg/day	7.5E-05	mg/kg/day	9.6E-03
				Copper	7.4E+02	mg/kg	2.1E-06	mg/kg/day	NA	NA	NA	6.0E-06	mg/kg/day	4.0E-02	mg/kg/day	1.5E-04
				Iron	7.9E+04	mg/kg	2.2E-04	mg/kg/day	NA	NA	NA	6.4E-04	mg/kg/day	3.0E-01	mg/kg/day	2.1E-03
				Manganese	4.9E+02	mg/kg	1.4E-06	mg/kg/day	NA	NA	NA	4.0E-06	mg/kg/day	8.0E-04	mg/kg/day	5.0E-03
				Thallium	5.2E+00	mg/kg	1.4E-08	mg/kg/day	NA	NA	NA	4.2E-08	mg/kg/day	7.0E-05	mg/kg/day	6.0E-04
				Vanadium	2.6E+01	mg/kg	7.3E-08	mg/kg/day	NA	NA	NA	2.1E-07	mg/kg/day	2.6E-05	mg/kg/day	8.2E-03
			Exp. Route Total								3.3E-07					2.9E-02
		Exposure Point Total									2.3E-06					1.4E-01
	Exposure Medium Total										2.3E-06					1.4E-01
Surface Soil Total											2.3E-06					1.4E-01
										Total of Receptor Risks Across All Media	2.3E-06				Total of Receptor Hazards Across All Media	1.4E-01

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Ingestion	Benzo(a)pyrene	2.8E-01	mg/kg	9.9E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.3E-07	2.8E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	5.8E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.2E-07	1.6E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	4.4E-03	mg/kg/day	NA	NA	NA	1.2E-02	mg/kg/day	1.0E+00	mg/kg/day	1.2E-02
				Antimony	4.8E+00	mg/kg	1.7E-06	mg/kg/day	NA	NA	NA	4.7E-06	mg/kg/day	4.0E-04	mg/kg/day	1.2E-02
				Arsenic	1.7E+01	mg/kg	5.9E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	8.9E-06	1.7E-05	mg/kg/day	3.0E-04	mg/kg/day	5.5E-02
				Cadmium	2.0E+01	mg/kg	7.1E-06	mg/kg/day	NA	NA	NA	2.0E-05	mg/kg/day	1.0E-03	mg/kg/day	2.0E-02
				Chromium	8.9E+01	mg/kg	3.1E-05	mg/kg/day	NA	NA	NA	8.7E-05	mg/kg/day	3.0E-03	mg/kg/day	2.9E-02
				Copper	7.4E+02	mg/kg	2.6E-04	mg/kg/day	NA	NA	NA	7.2E-04	mg/kg/day	4.0E-02	mg/kg/day	1.8E-02
				Iron	7.9E+04	mg/kg	2.8E-02	mg/kg/day	NA	NA	NA	7.7E-02	mg/kg/day	3.0E-01	mg/kg/day	2.6E-01
				Manganese	4.9E+02	mg/kg	1.7E-04	mg/kg/day	NA	NA	NA	4.8E-04	mg/kg/day	2.0E-02	mg/kg/day	2.4E-02
				Thallium	5.2E+00	mg/kg	1.8E-06	mg/kg/day	NA	NA	NA	5.1E-06	mg/kg/day	7.0E-05	mg/kg/day	7.3E-02
				Vanadium	2.6E+01	mg/kg	9.2E-06	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	1.0E-03	mg/kg/day	2.6E-02
			Exp. Route Total								1.0E-05					5.3E-01
			Dermal Absorption	Benzo(a)pyrene	2.8E-01	mg/kg	8.5E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	6.2E-07	2.4E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.7E-01	mg/kg	5.0E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.6E-07	1.4E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.3E+04	mg/kg	2.9E-04	mg/kg/day	NA	NA	NA	8.2E-04	mg/kg/day	1.0E+00	mg/kg/day	8.2E-04
				Antimony	4.8E+00	mg/kg	1.1E-07	mg/kg/day	NA	NA	NA	3.1E-07	mg/kg/day	6.0E-05	mg/kg/day	5.1E-03
				Arsenic	1.7E+01	mg/kg	1.2E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.8E-06	3.3E-06	mg/kg/day	3.0E-04	mg/kg/day	1.1E-02
				Cadmium	2.0E+01	mg/kg	4.7E-08	mg/kg/day	NA	NA	NA	1.3E-07	mg/kg/day	2.5E-05	mg/kg/day	5.3E-03
				Chromium	8.9E+01	mg/kg	2.0E-06	mg/kg/day	NA	NA	NA	5.7E-06	mg/kg/day	7.5E-05	mg/kg/day	7.7E-02
				Copper	7.4E+02	mg/kg	1.7E-05	mg/kg/day	NA	NA	NA	4.8E-05	mg/kg/day	4.0E-02	mg/kg/day	1.2E-03
				Iron	7.9E+04	mg/kg	1.8E-03	mg/kg/day	NA	NA	NA	5.1E-03	mg/kg/day	3.0E-01	mg/kg/day	1.7E-02
				Manganese	4.9E+02	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	3.2E-05	mg/kg/day	8.0E-04	mg/kg/day	4.0E-02
				Thallium	5.2E+00	mg/kg	1.2E-07	mg/kg/day	NA	NA	NA	3.4E-07	mg/kg/day	7.0E-05	mg/kg/day	4.8E-03
				Vanadium	2.6E+01	mg/kg	6.1E-07	mg/kg/day	NA	NA	NA	1.7E-06	mg/kg/day	2.6E-05	mg/kg/day	6.5E-02
			Exp. Route Total								2.7E-06					2.3E-01
		Exposure Point Total									1.3E-05					7.5E-01
	Exposure Medium Total										1.3E-05					7.5E-01
Surface Soil Total											1.3E-05					7.5E-01
										Total of Receptor Risks Across All Media	1.3E-05				Total of Receptor Hazards Across All Media	7.5E-01

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	4.1E-01	mg/kg	1.4E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.0E-08	9.7E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	1.1E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	8.0E-08	7.7E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	1.4E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.0E-08	1.0E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	7.6E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	5.6E-08	5.3E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	3.6E-04	mg/kg/day	NA	NA	NA	2.5E-02	mg/kg/day	1.0E+00	mg/kg/day	2.5E-02
				Antimony	7.3E+00	mg/kg	2.4E-07	mg/kg/day	NA	NA	NA	1.7E-05	mg/kg/day	2.0E-04	mg/kg/day	8.6E-02
				Arsenic	1.5E+01	mg/kg	5.2E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	7.8E-07	3.6E-05	mg/kg/day	3.0E-04	mg/kg/day	1.2E-01
				Cadmium	1.1E+01	mg/kg	3.6E-07	mg/kg/day	NA	NA	NA	2.5E-05	mg/kg/day	1.0E-03	mg/kg/day	2.5E-02
				Chromium	5.9E+01	mg/kg	2.0E-06	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	6.9E-03
				Copper	4.7E+02	mg/kg	1.6E-05	mg/kg/day	NA	NA	NA	1.1E-03	mg/kg/day	4.0E-02	mg/kg/day	2.7E-02
				Iron	3.4E+04	mg/kg	1.1E-03	mg/kg/day	NA	NA	NA	8.0E-02	mg/kg/day	3.0E-01	mg/kg/day	2.7E-01
				Manganese	3.9E+02	mg/kg	1.3E-05	mg/kg/day	NA	NA	NA	9.2E-04	mg/kg/day	2.0E-02	mg/kg/day	4.6E-02
				Thallium	5.2E+00	mg/kg	1.7E-07	mg/kg/day	NA	NA	NA	1.2E-05	mg/kg/day	7.0E-05	mg/kg/day	1.7E-01
				Vanadium	2.6E+01	mg/kg	8.7E-07	mg/kg/day	NA	NA	NA	6.1E-05	mg/kg/day	7.0E-03	mg/kg/day	8.7E-03
			Exp. Route Total								9.3E-07					7.9E-01
			Dermal Absorption	Benzo(a)anthracene	4.1E-01	mg/kg	2.5E-09	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.8E-09	1.7E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	2.0E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.4E-08	1.4E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	2.5E-09	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.9E-09	1.8E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	1.4E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.0E-08	9.6E-08	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	5.0E-06	mg/kg/day	NA	NA	NA	3.5E-04	mg/kg/day	1.0E+00	mg/kg/day	3.5E-04
				Antimony	7.3E+00	mg/kg	3.4E-09	mg/kg/day	NA	NA	NA	2.4E-07	mg/kg/day	3.0E-05	mg/kg/day	7.9E-03
				Arsenic	1.5E+01	mg/kg	2.1E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.2E-08	1.5E-06	mg/kg/day	3.0E-04	mg/kg/day	5.0E-03
				Cadmium	1.1E+01	mg/kg	4.9E-10	mg/kg/day	NA	NA	NA	3.4E-08	mg/kg/day	2.5E-05	mg/kg/day	1.4E-03
				Chromium	5.9E+01	mg/kg	2.7E-08	mg/kg/day	NA	NA	NA	1.9E-06	mg/kg/day	5.0E-04	mg/kg/day	3.8E-03
				Copper	4.7E+02	mg/kg	2.2E-07	mg/kg/day	NA	NA	NA	1.5E-05	mg/kg/day	4.0E-02	mg/kg/day	3.8E-04
				Iron	3.4E+04	mg/kg	1.6E-05	mg/kg/day	NA	NA	NA	1.1E-03	mg/kg/day	3.0E-01	mg/kg/day	3.7E-03
				Manganese	3.9E+02	mg/kg	1.8E-07	mg/kg/day	NA	NA	NA	1.3E-05	mg/kg/day	8.0E-04	mg/kg/day	1.6E-02
				Thallium	5.2E+00	mg/kg	2.4E-09	mg/kg/day	NA	NA	NA	1.7E-07	mg/kg/day	7.0E-05	mg/kg/day	2.4E-03
				Vanadium	2.6E+01	mg/kg	1.2E-08	mg/kg/day	NA	NA	NA	8.4E-07	mg/kg/day	1.8E-04	mg/kg/day	4.6E-03
			Exp. Route Total								6.0E-08					4.5E-02
		Exposure Point Total									9.9E-07					8.3E-01
	Exposure Medium Total										9.9E-07					8.3E-01
Soil* Total											9.9E-07					8.3E-01

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Groundwater	Area B, Site 11 Shallow Water	Dermal Absorption	Benzene	1.0E+00	µg/L	5.2E-08	mg/kg/day	5.5E-02	1/(mg/kg-day)	2.8E-09	3.6E-06	mg/kg/day	3.00E-03	mg/kg/day	1.2E-03
				Bromomethane	2.0E+00	µg/L	2.1E-08	mg/kg/day	NA	NA	NA	1.4E-06	mg/kg/day	1.4E-03	mg/kg/day	1.0E-03
				Antimony	2.9E+00	µg/L	9.7E-09	mg/kg/day	NA	NA	NA	6.8E-07	mg/kg/day	3.0E-05	mg/kg/day	2.3E-02
				Arsenic	2.9E+00	µg/L	9.7E-09	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.5E-08	6.8E-07	mg/kg/day	3.0E-04	mg/kg/day	2.3E-03
				Iron	4.5E+04	µg/L	1.5E-04	mg/kg/day	NA	NA	NA	1.0E-02	mg/kg/day	3.0E-01	mg/kg/day	3.5E-02
				Manganese	3.0E+03	µg/L	1.0E-05	mg/kg/day	NA	NA	NA	7.1E-04	mg/kg/day	8.0E-04	mg/kg/day	8.9E-01
			Exp. Route Total								1.7E-08					9.5E-01
		Exposure Point Total									1.7E-08					9.5E-01
		Area B, Site 11 Volatilization from Shallow Groundwater	Inhalation	Benzene	1.0E+00	µg/L	1.1E-07	mg/kg/day	2.9E-02	1/(mg/kg-day)	3.1E-09	7.4E-06	mg/kg/day	1.7E-02	mg/kg/day	4.4E-04
				Bromomethane	2.0E+00	µg/L	1.9E-07	mg/kg/day	NA	NA	NA	1.3E-05	mg/kg/day	1.4E-03	mg/kg/day	9.6E-03
			Exp. Route Total								3.1E-09					1.0E-02
		Exposure Point Total									3.1E-09					1.0E-02
	Exposure Medium Total										2.1E-08					9.6E-01
Groundwater Total											2.1E-08					9.6E-01
										Total of Receptor Risks Across All Media	1.0E-06				Total of Receptor Hazards Across All Media	1.8E+00

Table 7.4.RME Supplement A
Calculation of DAevent
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Benzene	1.00E+00	1.5E-02	5.1E-02	2.90E-01	7.0E-01	1.0E+00	8	1.2E-07	3
Bromomethane	2.00E+00	2.8E-03	1.1E-02	3.6E-01	8.7E-01	1.0E+00	8	4.9E-08	3
Antimony	2.90E+00	1.0E-03	NA	NA	NA	NA	8	2.3E-08	1
Arsenic	2.90E+00	1.0E-03	NA	NA	NA	NA	8	2.3E-08	1
Iron	4.47E+04	1.0E-03	NA	NA	NA	NA	8	3.6E-04	1
Manganese	3.02E+03	1.0E-03	NA	NA	NA	NA	8	2.4E-05	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =

$$\text{If } t_{event} \le t^*, \text{then } DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} \ge t^*, \text{then } DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$$

Notes:
Permeability constants (Kp), B, lag time, and t* from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below.
~~Parameters B, tau, and t* were calculated for MTBE; dibenzofuran;1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene.~~
Source for Kp for these constituents is ORNL RAIS database (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml). ~~Source for dibenzofuran Kp is the Region 9 PRG table.~~
NA - Not applicable.
tau - Lag time.
t* - Time to reach steady-state.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

Values for trans-1,2-Dichloroethene were used as surrogate for cis-1,2-dichloroethene.
Values for m-xylene were used as surrogate for total xylenes

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6} \right)$$

Where MW = Molecular weight and Kp = permeability constant. Values for both parameters were obtained from the RAIS database.

$$\tau_{event} = 0.105 \times 10^{(0.0056 MW)}$$

$$t^* = 2.4 \times \tau_{event}$$

If B < 0.6; used for dibenzofuran, MTBE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

$$t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2} \right)$$
$$b = \left(\frac{2(1+B)^2}{\pi} - c \right)$$
$$c = \left(\frac{1 + 3B + 3B^2}{3 \times (1+B)} \right)$$

If B > 0.6 (not used; shown for informational purposes only.)

Table 7.4.RME Supplement B
Inhalation of Volatiles from Groundwater During Construction
Inhalation Exposure Concentration Calculated Using EPA's Version of a Two-Film Volatilization Model
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

COPC	Groundwater Conc. (µg/L)	MW (g/mol)	Henry's Law Constant (atm-m3/mole)	kL (cm/s)	kG (cm/s)	K (cm/s)	F (g/m2-s)	Annual Average Ambient Conc (mg/m3)
Benzene	1.00E+00	78.11	5.54E-03	1.28E-03	0.50945352	1.27E-03	1.27E-08	7.57E-05
Bromomethane	2.00E+00	94.94	6.24E-03	1.16E-03	0.477216883	1.15E-03	2.30E-08	1.38E-04

Notes:

Emission estimation equation "Gaseous Emissions from Nonaerated Surface Impoundments, Open Top Wastewater Tanks and Containers, and Aqueous-Phase Contaminants Pooled at Soil Surfaces" from Air/Superfund National Technical Guidance Study Series, Guideline for Predictive Baseline Emissions Estimation for Superfund S
Air modeling performed using the SCREEN3 model and the user interface TSCREEN.

Parameter Description	Value	Units
Molecular weight (MW)	chem-specific	g/mol
Liquid phase transfer coefficient (kL)	chem-specific	cm/sec
Gas phase transfer coefficient (kG)	chem-specific	cm/sec
Maximum emission flux (F)	chem-specific	g/m2-sec

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	4.1E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	5.6E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	4.5E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	5.8E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	3.1E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.5E-02	mg/kg/day	1.0E+00	mg/kg/day	1.5E-02
				Antimony	7.3E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	4.0E-04	mg/kg/day	2.5E-02
				Arsenic	1.5E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	2.1E-05	mg/kg/day	3.0E-04	mg/kg/day	7.0E-02
				Cadmium	1.1E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.5E-05	mg/kg/day	1.0E-03	mg/kg/day	1.5E-02
				Chromium	5.9E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	8.0E-05	mg/kg/day	3.0E-03	mg/kg/day	2.7E-02
				Copper	4.7E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	6.4E-04	mg/kg/day	4.0E-02	mg/kg/day	1.6E-02
				Iron	3.4E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	4.7E-02	mg/kg/day	3.0E-01	mg/kg/day	1.6E-01
				Manganese	3.9E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	5.4E-04	mg/kg/day	2.0E-02	mg/kg/day	2.7E-02
				Thallium	5.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	7.1E-06	mg/kg/day	7.0E-05	mg/kg/day	1.0E-01
				Vanadium	2.6E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	3.6E-05	mg/kg/day	1.0E-03	mg/kg/day	3.6E-02
			Exp. Route Total								0.0E+00					4.9E-01
			Dermal Absorption	Benzo(a)anthracene	4.1E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	2.9E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	2.3E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	3.0E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.6E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	5.9E-04	mg/kg/day	1.0E+00	mg/kg/day	5.9E-04
				Antimony	7.3E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	4.0E-07	mg/kg/day	6.0E-05	mg/kg/day	6.6E-03
				Arsenic	1.5E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	2.5E-06	mg/kg/day	3.0E-04	mg/kg/day	8.4E-03
				Cadmium	1.1E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	5.8E-08	mg/kg/day	2.5E-05	mg/kg/day	2.3E-03
				Chromium	5.9E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	3.2E-06	mg/kg/day	7.5E-05	mg/kg/day	4.3E-02
				Copper	4.7E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	4.0E-02	mg/kg/day	6.4E-04
				Iron	3.4E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.9E-03	mg/kg/day	3.0E-01	mg/kg/day	6.2E-03
				Manganese	3.9E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	2.1E-05	mg/kg/day	8.0E-04	mg/kg/day	2.7E-02
				Thallium	5.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	2.8E-07	mg/kg/day	7.0E-05	mg/kg/day	4.1E-03
				Vanadium	2.6E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.4E-06	mg/kg/day	2.6E-05	mg/kg/day	5.5E-02
			Exp. Route Total								0.0E+00					1.5E-01
		Exposure Point Total									0.0E+00					6.4E-01
	Exposure Medium Total										0.0E+00					6.4E-01
Soil* Total											0.0E+00					6.4E-01

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	2.7E-05	mg/kg/day	4.0E-03	mg/kg/day	6.8E-03
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	5.5E-05	mg/kg/day	1.4E-03	mg/kg/day	3.9E-02
				Antimony	2.9E+00	µg/L	NA	mg/kg/day	NA	NA	NA	7.9E-05	mg/kg/day	4.0E-04	mg/kg/day	2.0E-01
				Arsenic	2.9E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	7.9E-05	mg/kg/day	3.0E-04	mg/kg/day	2.6E-01
				Iron	4.5E+04	µg/L	NA	mg/kg/day	NA	NA	NA	1.2E+00	mg/kg/day	3.0E-01	mg/kg/day	4.1E+00
				Manganese	3.0E+03	µg/L	NA	mg/kg/day	NA	NA	NA	8.3E-02	mg/kg/day	2.0E-02	mg/kg/day	4.1E+00
			Exp. Route Total								0.0E+00					8.7E+00
			Dermal Absorption	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	4.2E-06	mg/kg/day	4.00E-03	mg/kg/day	1.0E-03
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.8E-06	mg/kg/day	1.4E-03	mg/kg/day	1.3E-03
				Antimony	2.9E+00	µg/L	NA	mg/kg/day	NA	NA	NA	4.1E-07	mg/kg/day	6.0E-05	mg/kg/day	6.9E-03
				Arsenic	2.9E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	4.1E-07	mg/kg/day	3.0E-04	mg/kg/day	1.4E-03
				Iron	4.5E+04	µg/L	NA	mg/kg/day	NA	NA	NA	6.4E-03	mg/kg/day	3.0E-01	mg/kg/day	2.1E-02
				Manganese	3.0E+03	µg/L	NA	mg/kg/day	NA	NA	NA	4.3E-04	mg/kg/day	8.0E-04	mg/kg/day	5.4E-01
			Exp. Route Total								0.0E+00					5.7E-01
		Exposure Point Total									0.0E+00					9.3E+00
		Area B, Site 11 Shallow Aquifer - Water Vapors at Showerhead	Inhalation	Benzene	1.0E+00	µg/L	NA	mg/kg/day	2.9E-02	1/(mg/kg-day)	NA	2.5E-05	mg/kg/day	8.6E-03	mg/kg/day	2.9E-03
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	4.5E-05	mg/kg/day	1.4E-03	mg/kg/day	3.2E-02
			Exp. Route Total								0.0E+00					3.5E-02
		Exposure Point Total									0.0E+00					3.5E-02
	Exposure Medium Total										0.0E+00					9.3E+00
Groundwater Total											0.0E+00					9.3E+00
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	1.0E+01

Table 7.5.RME Supplement A
Calculation of DAevent
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm²-event)	Eq
Benzene	1.00E+00	1.5E-02	5.1E-02	2.90E-01	7.0E-01	1.0E+00	0.58	1.7E-08	2
Bromomethane	2.00E+00	2.8E-03	1.1E-02	3.6E-01	8.7E-01	1.0E+00	0.58	7.2E-09	2
Antimony	2.90E+00	1.0E-03	NA	NA	NA	NA	0.58	1.7E-09	1
Arsenic	2.90E+00	1.0E-03	NA	NA	NA	NA	0.58	1.7E-09	1
Iron	4.47E+04	1.0E-03	NA	NA	NA	NA	0.58	2.6E-05	1
Manganese	3.02E+03	1.0E-03	NA	NA	NA	NA	0.58	1.8E-06	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm³ (eq 1)

Organics: DAevent (mg/cm2-event) =

$$\text{If } t_{event} \le t^*, \text{then } DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} \ge t^*, \text{then } DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Notes:
Permeability constants (Kp), B, lag time, and t* from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below.
~~Parameters B, tau, and t* were calculated for MTBE; dibenzofuran;1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene.~~
Source for Kp for these constituents is ORNL RAIS database (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml). ~~Source for dibenzofuran Kp is the Region 9 PRG table.~~
NA - Not applicable.
tau - Lag time.
t* - Time to reach steady-state.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

Values for trans-1,2-Dichloroethene were used as surrogate for cis-1,2-dichloroethene.
Values for m-xylene were used as surrogate for total xylenes

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6}\right)$$

Where MW = Molecular weight and Kp = permeability constant. Values for both parameters were obtained from the RAIS database.

$$\tau_{event} = 0.105 \times 10^{(0.0056 MW)}$$

$$t^* = 2.4 \times \tau_{event}$$

If B < 0.6; used for dibenzofuran, MTBE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

$$t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2}\right)$$
$$b = \left(\frac{2(1+B)^2}{\pi} - c\right)$$
$$c = \left(\frac{1+3B+3B^2}{3 \times (1+B)}\right)$$

If B > 0.6 (not used; shown for informational purposes only.)

Table 7.5.RME and 7.7.RME Supplement B

Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model

Site 11 Feasibility Study

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 - min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Benzene	1.0E+00	7.8E+01	5.55E-03	1.4E+03	1.5E+01	1.4E+01	1.9E+01	1.5E-01	1.2E-01	2.6E-05
Bromomethane	2.0E+00	9.5E+01	6.24E-03	1.3E+03	1.4E+01	1.3E+01	1.8E+01	2.7E-01	2.3E-01	4.7E-05

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	34.8
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.01667
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	$3000 * (18 / HH)^{0.5}$
Equation 2:	Kl(VOC) =	$20 * (44 / HH)^{0.5}$
Equation 3:	KL =	$((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))^{-1}$
Equation 4:	Kal =	$(KL * (((Tl * Us) / (Ts * Ul))^{-0.5}))$
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))
Equation 6:	S =	(Cwd * FR / SV)
Equation 7:	see time series example on Table I-GW-5	
Equation 8:	Einh =	If t>Ds (((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

Henry's Law Constant from USEPA's *Superfund Public Health Evaluation Manual.* USEPA/540/1-86/060, October 1986.

~~Notes:~~

~~C11-C22 Aromatic Hydrocarbons (used MW for anthracene, a 3-ring aromatic, Henry's Law from Mass. Issue Paper)~~

~~C19-C36 Aliphatic Hydrocarbons (used data for eicosane, a C20)~~

~~VPH C9-C10 Aromatics (Used MW for cumeme a C9, Henry's Law from Mass. Issue Paper)~~

~~VPH C9-C12 Aliphatics (Used MW for a C10 linear from CHEMDAT8, Henry's Law from Mass. Issue Paper)~~

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	4.1E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	5.3E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	4.2E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	5.4E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	2.9E-06	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.4E-01	mg/kg/day	1.0E+00	mg/kg/day	1.4E-01
				Antimony	7.3E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	9.3E-05	mg/kg/day	4.0E-04	mg/kg/day	2.3E-01
				Arsenic	1.5E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	2.0E-04	mg/kg/day	3.0E-04	mg/kg/day	6.6E-01
				Cadmium	1.1E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	1.0E-03	mg/kg/day	1.4E-01
				Chromium	5.9E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	7.5E-04	mg/kg/day	3.0E-03	mg/kg/day	2.5E-01
				Copper	4.7E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	6.0E-03	mg/kg/day	4.0E-02	mg/kg/day	1.5E-01
				Iron	3.4E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	4.4E-01	mg/kg/day	3.0E-01	mg/kg/day	1.5E+00
				Manganese	3.9E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	5.0E-03	mg/kg/day	2.0E-02	mg/kg/day	2.5E-01
				Thallium	5.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	6.6E-05	mg/kg/day	7.0E-05	mg/kg/day	9.5E-01
				Vanadium	2.6E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	3.3E-04	mg/kg/day	1.0E-03	mg/kg/day	3.3E-01
			Exp. Route Total								0.0E+00					4.6E+00
			Dermal Absorption	Benzo(a)anthracene	4.1E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.9E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.5E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	2.0E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.1E-06	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	3.9E-03	mg/kg/day	1.0E+00	mg/kg/day	3.9E-03
				Antimony	7.3E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	2.6E-06	mg/kg/day	6.0E-05	mg/kg/day	4.4E-02
				Arsenic	1.5E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	1.7E-05	mg/kg/day	3.0E-04	mg/kg/day	5.5E-02
				Cadmium	1.1E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	3.8E-07	mg/kg/day	2.5E-05	mg/kg/day	1.5E-02
				Chromium	5.9E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	2.1E-05	mg/kg/day	7.5E-05	mg/kg/day	2.8E-01
				Copper	4.7E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.7E-04	mg/kg/day	4.0E-02	mg/kg/day	4.2E-03
				Iron	3.4E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.2E-02	mg/kg/day	3.0E-01	mg/kg/day	4.1E-02
				Manganese	3.9E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.4E-04	mg/kg/day	8.0E-04	mg/kg/day	1.8E-01
				Thallium	5.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	1.9E-06	mg/kg/day	7.0E-05	mg/kg/day	2.7E-02
				Vanadium	2.6E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	9.3E-06	mg/kg/day	2.6E-05	mg/kg/day	3.6E-01
			Exp. Route Total								0.0E+00					1.0E+00
		Exposure Point Total									0.0E+00					5.6E+00
	Exposure Medium Total										0.0E+00					5.6E+00
Soil* Total											0.0E+00					5.6E+00

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	6.4E-05	mg/kg/day	4.0E-03	mg/kg/day	1.6E-02
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.3E-04	mg/kg/day	1.4E-03	mg/kg/day	9.1E-02
				Antimony	2.9E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.9E-04	mg/kg/day	4.0E-04	mg/kg/day	4.6E-01
				Arsenic	2.9E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	1.9E-04	mg/kg/day	3.0E-04	mg/kg/day	6.2E-01
				Iron	4.5E+04	µg/L	NA	mg/kg/day	NA	NA	NA	2.9E+00	mg/kg/day	3.0E-01	mg/kg/day	9.5E+00
				Manganese	3.0E+03	µg/L	NA	mg/kg/day	NA	NA	NA	1.9E-01	mg/kg/day	2.0E-02	mg/kg/day	9.7E+00
			Exp. Route Total								0.0E+00					2.0E+01
			Dermal Absorption	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	9.9E-06	mg/kg/day	4.00E-03	mg/kg/day	2.5E-03
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	4.1E-06	mg/kg/day	1.4E-03	mg/kg/day	2.9E-03
				Antimony	2.9E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.2E-06	mg/kg/day	6.0E-05	mg/kg/day	2.0E-02
				Arsenic	2.9E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	1.2E-06	mg/kg/day	3.0E-04	mg/kg/day	4.1E-03
				Iron	4.5E+04	µg/L	NA	mg/kg/day	NA	NA	NA	1.9E-02	mg/kg/day	3.0E-01	mg/kg/day	6.3E-02
				Manganese	3.0E+03	µg/L	NA	mg/kg/day	NA	NA	NA	1.3E-03	mg/kg/day	8.0E-04	mg/kg/day	1.6E+00
			Exp. Route Total								0.0E+00					1.7E+00
		Exposure Point Total									0.0E+00					2.2E+01
	Exposure Medium Total										0.0E+00					2.2E+01
Groundwater Total											0.0E+00					2.2E+01
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	2.8E+01

Table 7.6.RME Supplement A
Calculation of DAevent
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm²-event)	Eq
Benzene	1.00E+00	1.5E-02	5.1E-02	2.90E-01	7.0E-01	1.0E+00	1	2.3E-08	3
Bromomethane	2.00E+00	2.8E-03	1.1E-02	3.6E-01	8.7E-01	1.0E+00	1	9.8E-09	3
Antimony	2.90E+00	1.0E-03	NA	NA	NA	NA	1	2.9E-09	1
Arsenic	2.90E+00	1.0E-03	NA	NA	NA	NA	1	2.9E-09	1
Iron	4.47E+04	1.0E-03	NA	NA	NA	NA	1	4.5E-05	1
Manganese	3.02E+03	1.0E-03	NA	NA	NA	NA	1	3.0E-06	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm³ (eq 1)

Organics: DAevent (mg/cm2-event) =

$$\text{If } t_{event} \le t^*, \text{then } DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} \ge t^*, \text{then } DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Notes:
Permeability constants (Kp), B, lag time, and t* from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below.
~~Parameters B, tau, and t* were calculated for MTBE; dibenzofuran;1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene.~~
Source for Kp for these constituents is ORNL RAIS database (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml). ~~Source for dibenzofuran Kp is the Region 9 PRG table~~.
NA - Not applicable.
tau - Lag time.
t* - Time to reach steady-state.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

Values for trans-1,2-Dichloroethene were used as surrogate for cis-1,2-dichloroethene.
Values for m-xylene were used as surrogate for total xylenes

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6}\right)$$

Where MW = Molecular weight and Kp = permeability constant. Values for both parameters were obtained from the RAIS database.

$$\tau_{event} = 0.105 \times 10^{(0.0056 MW)}$$

$$t^* = 2.4 \times \tau_{event}$$

If B < 0.6; used for dibenzofuran, MTBE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

$$t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2}\right)$$
$$b = \left(\frac{2(1+B)^2}{\pi} - c\right)$$
$$c = \left(\frac{1+3B+3B^2}{3 \times (1+B)}\right)$$

If B > 0.6 (not used; shown for informational purposes only.)

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	4.1E-01	mg/kg	6.5E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	4.7E-07	NA	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	5.1E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	3.7E-06	NA	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	6.6E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	4.8E-07	NA	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	3.6E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.6E-06	NA	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	1.7E-02	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E+00	mg/kg/day	NA
				Antimony	7.3E+00	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-04	mg/kg/day	NA
				Arsenic	1.5E+01	mg/kg	2.4E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.6E-05	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Cadmium	1.1E+01	mg/kg	1.7E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E-03	mg/kg/day	NA
				Chromium	5.9E+01	mg/kg	9.2E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-03	mg/kg/day	NA
				Copper	4.7E+02	mg/kg	7.3E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-02	mg/kg/day	NA
				Iron	3.4E+04	mg/kg	5.4E-02	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	3.9E+02	mg/kg	6.1E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.0E-02	mg/kg/day	NA
				Thallium	5.2E+00	mg/kg	8.1E-06	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.0E-05	mg/kg/day	NA
				Vanadium	2.6E+01	mg/kg	4.1E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E-03	mg/kg/day	NA
			Exp. Route Total								4.4E-05					0.0E+00
			Dermal Absorption	Benzo(a)anthracene	4.1E-01	mg/kg	2.6E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.9E-07	NA	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	2.1E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.5E-06	NA	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	2.7E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.0E-07	NA	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	1.5E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	1.1E-06	NA	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	5.4E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E+00	mg/kg/day	NA
				Antimony	7.3E+00	mg/kg	3.6E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	6.0E-05	mg/kg/day	NA
				Arsenic	1.5E+01	mg/kg	2.3E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.4E-06	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Cadmium	1.1E+01	mg/kg	5.3E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.5E-05	mg/kg/day	NA
				Chromium	5.9E+01	mg/kg	2.9E-06	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.5E-05	mg/kg/day	NA
				Copper	4.7E+02	mg/kg	2.3E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-02	mg/kg/day	NA
				Iron	3.4E+04	mg/kg	1.7E-03	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	3.9E+02	mg/kg	1.9E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	8.0E-04	mg/kg/day	NA
				Thallium	5.2E+00	mg/kg	2.6E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.0E-05	mg/kg/day	NA
				Vanadium	2.6E+01	mg/kg	1.3E-06	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.6E-05	mg/kg/day	NA
			Exp. Route Total								6.4E-06					0.0E+00
		Exposure Point Total									5.0E-05					0.0E+00
	Exposure Medium Total										5.0E-05					0.0E+00
Soil* Total											5.0E-05					0.0E+00

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	1.5E-05	mg/kg/day	5.5E-02	1/(mg/kg-day)	8.2E-07	NA	mg/kg/day	4.0E-03	mg/kg/day	NA
				Bromomethane	2.0E+00	µg/L	3.0E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.4E-03	mg/kg/day	NA
				Antimony	2.9E+00	µg/L	4.3E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-04	mg/kg/day	NA
				Arsenic	2.9E+00	µg/L	4.3E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.5E-05	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Iron	4.5E+04	µg/L	6.7E-01	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	3.0E+03	µg/L	4.5E-02	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.0E-02	mg/kg/day	NA
			Exp. Route Total								6.6E-05					0.0E+00
			Dermal Absorption	Benzene	1.0E+00	µg/L	2.3E-06	mg/kg/day	5.5E-02	1/(mg/kg-day)	1.3E-07	NA	mg/kg/day	4.00E-03	mg/kg/day	NA
				Bromomethane	2.0E+00	µg/L	9.6E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.4E-03	mg/kg/day	NA
				Antimony	2.9E+00	µg/L	2.5E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	6.0E-05	mg/kg/day	NA
				Arsenic	2.9E+00	µg/L	2.5E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.7E-07	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Iron	4.5E+04	µg/L	3.8E-03	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	3.0E+03	µg/L	2.6E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	8.0E-04	mg/kg/day	NA
			Exp. Route Total								5.0E-07					0.0E+00
		Exposure Point Total									6.6E-05					0.0E+00
		Shallow Aquifer - Water Vapors at Showerhead	Inhalation	Benzene	1.0E+00	µg/L	8.4E-06	mg/kg/day	2.9E-02	1/(mg/kg-day)	2.4E-07	NA	mg/kg/day	8.6E-03	mg/kg/day	NA
				Bromomethane	2.0E+00	µg/L	1.5E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.4E-03	mg/kg/day	NA
			Exp. Route Total								2.4E-07					0.0E+00
		Exposure Point Total									2.4E-07					0.0E+00
	Exposure Medium Total										6.7E-05					0.0E+00
Groundwater Total											6.7E-05					0.0E+00
									Total of Receptor Risks Across All Media		1.2E-04	Total of Receptor Hazards Across All Media				0.0E+00

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	4.1E-01	mg/kg	1.4E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.1E-07	4.0E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	1.1E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	8.3E-07	3.2E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	1.5E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	1.1E-07	4.2E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	8.0E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	5.8E-07	2.2E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	3.8E-03	mg/kg/day	NA	NA	NA	1.1E-02	mg/kg/day	1.0E+00	mg/kg/day	1.1E-02
				Antimony	7.3E+00	mg/kg	2.5E-06	mg/kg/day	NA	NA	NA	7.1E-06	mg/kg/day	4.0E-04	mg/kg/day	1.8E-02
				Arsenic	1.5E+01	mg/kg	5.4E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	8.1E-06	1.5E-05	mg/kg/day	3.0E-04	mg/kg/day	5.0E-02
				Cadmium	1.1E+01	mg/kg	3.7E-06	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	1.0E-03	mg/kg/day	1.0E-02
				Chromium	5.9E+01	mg/kg	2.0E-05	mg/kg/day	NA	NA	NA	5.7E-05	mg/kg/day	3.0E-03	mg/kg/day	1.9E-02
				Copper	4.7E+02	mg/kg	1.6E-04	mg/kg/day	NA	NA	NA	4.6E-04	mg/kg/day	4.0E-02	mg/kg/day	1.1E-02
				Iron	3.4E+04	mg/kg	1.2E-02	mg/kg/day	NA	NA	NA	3.3E-02	mg/kg/day	3.0E-01	mg/kg/day	1.1E-01
				Manganese	3.9E+02	mg/kg	1.4E-04	mg/kg/day	NA	NA	NA	3.8E-04	mg/kg/day	2.0E-02	mg/kg/day	1.9E-02
				Thallium	5.2E+00	mg/kg	1.8E-06	mg/kg/day	NA	NA	NA	5.1E-06	mg/kg/day	7.0E-05	mg/kg/day	7.3E-02
				Vanadium	2.6E+01	mg/kg	9.1E-06	mg/kg/day	NA	NA	NA	2.5E-05	mg/kg/day	1.0E-03	mg/kg/day	2.5E-02
			Exp. Route Total								9.7E-06					3.5E-01
			Dermal Absorption	Benzo(a)anthracene	4.1E-01	mg/kg	1.2E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	9.0E-08	3.5E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	3.3E-01	mg/kg	9.8E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.1E-07	2.7E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	4.2E-01	mg/kg	1.3E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	9.3E-08	3.6E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	2.3E-01	mg/kg	6.8E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	5.0E-07	1.9E-07	mg/kg/day	NA	NA	NA
				Aluminum	1.1E+04	mg/kg	2.5E-04	mg/kg/day	NA	NA	NA	7.0E-04	mg/kg/day	1.0E+00	mg/kg/day	7.0E-04
				Antimony	7.3E+00	mg/kg	1.7E-07	mg/kg/day	NA	NA	NA	4.7E-07	mg/kg/day	6.0E-05	mg/kg/day	7.9E-03
				Arsenic	1.5E+01	mg/kg	1.1E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.6E-06	3.0E-06	mg/kg/day	3.0E-04	mg/kg/day	1.0E-02
				Cadmium	1.1E+01	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	6.9E-08	mg/kg/day	2.5E-05	mg/kg/day	2.8E-03
				Chromium	5.9E+01	mg/kg	1.4E-06	mg/kg/day	NA	NA	NA	3.8E-06	mg/kg/day	7.5E-05	mg/kg/day	5.0E-02
				Copper	4.7E+02	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	3.0E-05	mg/kg/day	4.0E-02	mg/kg/day	7.5E-04
				Iron	3.4E+04	mg/kg	7.9E-04	mg/kg/day	NA	NA	NA	2.2E-03	mg/kg/day	3.0E-01	mg/kg/day	7.4E-03
				Manganese	3.9E+02	mg/kg	9.0E-06	mg/kg/day	NA	NA	NA	2.5E-05	mg/kg/day	8.0E-04	mg/kg/day	3.2E-02
				Thallium	5.2E+00	mg/kg	1.2E-07	mg/kg/day	NA	NA	NA	3.4E-07	mg/kg/day	7.0E-05	mg/kg/day	4.8E-03
				Vanadium	2.6E+01	mg/kg	6.0E-07	mg/kg/day	NA	NA	NA	1.7E-06	mg/kg/day	2.6E-05	mg/kg/day	6.5E-02
			Exp. Route Total								3.0E-06					1.8E-01
		Exposure Point Total									1.3E-05					5.3E-01
	Exposure Medium Total										1.3E-05					5.3E-01
Soil* Total											1.3E-05					5.3E-01
										Total of Receptor Risks Across All Media	1.3E-05				Total of Receptor Hazards Across All Media	5.3E-01

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer Risk Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk	Non-Cancer Hazard Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	RfD/RfC Value	RfD/RfC Units	Hazard Quotient
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	2.4E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.1E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.1E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.3E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	6.2E-08	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	NA	mg/kg/day	NA	NA	NA	4.2E-03	mg/kg/day	1.0E+00	mg/kg/day	4.2E-03
				Antimony	1.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	8.5E-07	mg/kg/day	4.0E-04	mg/kg/day	2.1E-03
				Arsenic	1.0E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	4.7E-06	mg/kg/day	3.0E-04	mg/kg/day	1.6E-02
				Cadmium	4.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	2.2E-06	mg/kg/day	1.0E-03	mg/kg/day	2.2E-03
				Chromium	2.8E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.3E-05	mg/kg/day	3.0E-03	mg/kg/day	4.2E-03
				Copper	2.3E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.1E-04	mg/kg/day	4.0E-02	mg/kg/day	2.6E-03
				Iron	2.5E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.1E-02	mg/kg/day	3.0E-01	mg/kg/day	3.8E-02
				Manganese	2.8E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.3E-04	mg/kg/day	2.0E-02	mg/kg/day	6.4E-03
				Thallium	1.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	5.6E-07	mg/kg/day	7.0E-05	mg/kg/day	8.0E-03
				Vanadium	2.4E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.1E-05	mg/kg/day	1.0E-03	mg/kg/day	1.1E-02
			Exp. Route Total								0.0E+00					9.4E-02
			Dermal Absorption	Benzo(a)anthracene	2.4E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.1E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.1E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.4E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	6.4E-08	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	NA	mg/kg/day	NA	NA	NA	3.4E-04	mg/kg/day	1.0E+00	mg/kg/day	3.4E-04
				Antimony	1.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	6.8E-08	mg/kg/day	6.0E-05	mg/kg/day	1.1E-03
				Arsenic	1.0E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	1.1E-06	mg/kg/day	3.0E-04	mg/kg/day	3.7E-03
				Cadmium	4.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	1.8E-08	mg/kg/day	2.5E-05	mg/kg/day	7.1E-04
				Chromium	2.8E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.0E-06	mg/kg/day	7.5E-05	mg/kg/day	1.3E-02
				Copper	2.3E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	8.4E-06	mg/kg/day	4.0E-02	mg/kg/day	2.1E-04
				Iron	2.5E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	9.1E-04	mg/kg/day	3.0E-01	mg/kg/day	3.0E-03
				Manganese	2.8E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	8.0E-04	mg/kg/day	1.3E-02
				Thallium	1.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	4.5E-08	mg/kg/day	7.0E-05	mg/kg/day	6.4E-04
				Vanadium	2.4E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	8.8E-07	mg/kg/day	2.6E-05	mg/kg/day	3.4E-02
			Exp. Route Total								0.0E+00					7.0E-02
		Exposure Point Total									0.0E+00					1.6E-01
	Exposure Medium Total										0.0E+00					1.6E-01
Soil* Total											0.0E+00					1.6E-01

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	1.3E-05	mg/kg/day	4.0E-03	mg/kg/day	3.2E-03
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	2.6E-05	mg/kg/day	1.4E-03	mg/kg/day	1.8E-02
				Antimony	1.8E+00	µg/L	NA	mg/kg/day	NA	NA	NA	2.3E-05	mg/kg/day	4.0E-04	mg/kg/day	5.8E-02
				Arsenic	1.5E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	2.0E-05	mg/kg/day	3.0E-04	mg/kg/day	6.6E-02
				Iron	3.9E+04	µg/L	NA	mg/kg/day	NA	NA	NA	5.0E-01	mg/kg/day	3.0E-01	mg/kg/day	1.7E+00
				Manganese	2.4E+03	µg/L	NA	mg/kg/day	NA	NA	NA	3.0E-02	mg/kg/day	2.0E-02	mg/kg/day	1.5E+00
			Exp. Route Total								0.0E+00					3.3E+00
			Dermal Absorption	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	1.8E-06	mg/kg/day	4.00E-03	mg/kg/day	4.6E-04
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	7.8E-07	mg/kg/day	1.4E-03	mg/kg/day	5.6E-04
				Antimony	1.8E+00	µg/L	NA	mg/kg/day	NA	NA	NA	7.5E-08	mg/kg/day	6.0E-05	mg/kg/day	1.2E-03
				Arsenic	1.5E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	6.3E-08	mg/kg/day	3.0E-04	mg/kg/day	2.1E-04
				Iron	3.9E+04	µg/L	NA	mg/kg/day	NA	NA	NA	1.6E-03	mg/kg/day	3.0E-01	mg/kg/day	5.4E-03
				Manganese	2.4E+03	µg/L	NA	mg/kg/day	NA	NA	NA	9.7E-05	mg/kg/day	8.0E-04	mg/kg/day	1.2E-01
			Exp. Route Total								0.0E+00					1.3E-01
		Exposure Point Total									0.0E+00					3.5E+00
	Exposure Medium Total										0.0E+00					3.5E+00
Groundwater Total											0.0E+00					3.5E+00
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	3.6E+00

Table 7.1.CTE Supplement A
Calculation of DAevent
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm²-event)	Eq
Benzene	1.00E+00	1.5E-02	5.1E-02	2.90E-01	7.0E-01	1.0E+00	0.25	1.1E-08	2
Bromomethane	2.00E+00	2.8E-03	1.1E-02	3.6E-01	8.7E-01	1.0E+00	0.25	4.7E-09	2
Antimony	1.82E+00	1.0E-03	NA	NA	NA	NA	0.25	4.5E-10	1
Arsenic	1.53E+00	1.0E-03	NA	NA	NA	NA	0.25	3.8E-10	1
Iron	3.94E+04	1.0E-03	NA	NA	NA	NA	0.25	9.8E-06	1
Manganese	2.36E+03	1.0E-03	NA	NA	NA	NA	0.25	5.9E-07	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm³ (eq 1)

Organics: DAevent (mg/cm2-event) =

$$\text{If } t_{event} \leq t^*, \text{then } DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} \geq t^*, \text{then } DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Notes:
Permeability constants (Kp), B, lag time, and t* from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below.
Parameters B, tau, and t* were calculated for MTBE; dibenzofuran;1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene.
Source for Kp for these constituents is ORNL RAIS database (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml). Source for dibenzofuran Kp is the Region 9 PRG table.
NA - Not applicable.
tau - Lag time.
t* - Time to reach steady-state.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

Values for trans-1,2-Dichloroethene were used as surrogate for cis-1,2-dichloroethene.
Values for m-xylene were used as surrogate for total xylenes

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6}\right)$$

Where MW = Molecular weight and Kp = permeability constant. Values for both parameters were obtained from the RAIS database.

$$\tau_{event} = 0.105 \times 10^{(0.0056 MW)}$$

$$t^* = 2.4 \times \tau_{event}$$

If B < 0.6; used for dibenzofuran, MTBE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

$$t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2}\right)$$
$$b = \left(\frac{2(1+B)^2}{\pi} - c\right)$$
$$c = \left(\frac{1+3B+3B^2}{3 \times (1+B)}\right)$$

If B > 0.6 (not used; shown for informational purposes only.)

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	2.4E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.0E-06	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	1.0E-06	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	1.2E-06	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	5.8E-07	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	NA	mg/kg/day	NA	NA	NA	3.9E-02	mg/kg/day	1.0E+00	mg/kg/day	3.9E-02
				Antimony	1.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	8.0E-06	mg/kg/day	4.0E-04	mg/kg/day	2.0E-02
				Arsenic	1.0E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	4.4E-05	mg/kg/day	3.0E-04	mg/kg/day	1.5E-01
				Cadmium	4.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	2.1E-05	mg/kg/day	1.0E-03	mg/kg/day	2.1E-02
				Chromium	2.8E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	3.0E-03	mg/kg/day	3.9E-02
				Copper	2.3E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	9.8E-04	mg/kg/day	4.0E-02	mg/kg/day	2.5E-02
				Iron	2.5E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	1.1E-01	mg/kg/day	3.0E-01	mg/kg/day	3.5E-01
				Manganese	2.8E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	1.2E-03	mg/kg/day	2.0E-02	mg/kg/day	6.0E-02
				Thallium	1.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	5.2E-06	mg/kg/day	7.0E-05	mg/kg/day	7.4E-02
				Vanadium	2.4E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	1.0E-04	mg/kg/day	1.0E-03	mg/kg/day	1.0E-01
			Exp. Route Total								0.0E+00					8.8E-01
			Dermal Absorption	Benzo(a)anthracene	2.4E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	7.5E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	7.2E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	NA	mg/kg/day	7.3E-01	1/(mg/kg-day)	NA	9.0E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	NA	mg/kg/day	7.3E+00	1/(mg/kg-day)	NA	4.2E-07	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	NA	mg/kg/day	NA	NA	NA	2.2E-03	mg/kg/day	1.0E+00	mg/kg/day	2.2E-03
				Antimony	1.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	4.5E-07	mg/kg/day	6.0E-05	mg/kg/day	7.4E-03
				Arsenic	1.0E+01	mg/kg	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	7.4E-06	mg/kg/day	3.0E-04	mg/kg/day	2.5E-02
				Cadmium	4.9E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	1.2E-07	mg/kg/day	2.5E-05	mg/kg/day	4.7E-03
				Chromium	2.8E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	6.6E-06	mg/kg/day	7.5E-05	mg/kg/day	8.8E-02
				Copper	2.3E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	5.5E-05	mg/kg/day	4.0E-02	mg/kg/day	1.4E-03
				Iron	2.5E+04	mg/kg	NA	mg/kg/day	NA	NA	NA	5.9E-03	mg/kg/day	3.0E-01	mg/kg/day	2.0E-02
				Manganese	2.8E+02	mg/kg	NA	mg/kg/day	NA	NA	NA	6.7E-05	mg/kg/day	8.0E-04	mg/kg/day	8.4E-02
				Thallium	1.2E+00	mg/kg	NA	mg/kg/day	NA	NA	NA	2.9E-07	mg/kg/day	7.0E-05	mg/kg/day	4.2E-03
				Vanadium	2.4E+01	mg/kg	NA	mg/kg/day	NA	NA	NA	5.8E-06	mg/kg/day	2.6E-05	mg/kg/day	2.2E-01
			Exp. Route Total								0.0E+00					4.6E-01
		Exposure Point Total									0.0E+00					1.3E+00
	Exposure Medium Total										0.0E+00					1.3E+00
Soil* Total											0.0E+00					1.3E+00

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer: Intake/Exposure Concentration Value	Cancer: Intake/Exposure Concentration Units	CSF/Unit Risk Value	CSF/Unit Risk Units	Cancer Risk	Non-Cancer: Intake/Exposure Concentration Value	Non-Cancer: Intake/Exposure Concentration Units	RfD/RfC Value	RfD/RfC Units	Hazard Quotient
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	4.3E-05	mg/kg/day	4.0E-03	mg/kg/day	1.1E-02
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	8.5E-05	mg/kg/day	1.4E-03	mg/kg/day	6.1E-02
				Antimony	1.8E+00	µg/L	NA	mg/kg/day	NA	NA	NA	7.8E-05	mg/kg/day	4.0E-04	mg/kg/day	1.9E-01
				Arsenic	1.5E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	6.6E-05	mg/kg/day	3.0E-04	mg/kg/day	2.2E-01
				Iron	3.9E+04	µg/L	NA	mg/kg/day	NA	NA	NA	1.7E+00	mg/kg/day	3.0E-01	mg/kg/day	5.6E+00
				Manganese	2.4E+03	µg/L	NA	mg/kg/day	NA	NA	NA	1.0E-01	mg/kg/day	2.0E-02	mg/kg/day	5.0E+00
			Exp. Route Total								0.0E+00					1.1E+01
			Dermal Absorption	Benzene	1.0E+00	µg/L	NA	mg/kg/day	5.5E-02	1/(mg/kg-day)	NA	3.6E-06	mg/kg/day	4.00E-03	mg/kg/day	9.0E-04
				Bromomethane	2.0E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.5E-06	mg/kg/day	1.4E-03	mg/kg/day	1.1E-03
				Antimony	1.8E+00	µg/L	NA	mg/kg/day	NA	NA	NA	1.7E-07	mg/kg/day	6.0E-05	mg/kg/day	2.8E-03
				Arsenic	1.5E+00	µg/L	NA	mg/kg/day	1.5E+00	1/(mg/kg-day)	NA	1.4E-07	mg/kg/day	3.0E-04	mg/kg/day	4.8E-04
				Iron	3.9E+04	µg/L	NA	mg/kg/day	NA	NA	NA	3.7E-03	mg/kg/day	3.0E-01	mg/kg/day	1.2E-02
				Manganese	2.4E+03	µg/L	NA	mg/kg/day	NA	NA	NA	2.2E-04	mg/kg/day	8.0E-04	mg/kg/day	2.7E-01
			Exp. Route Total								0.0E+00					2.9E-01
		Exposure Point Total									0.0E+00					1.1E+01
	Exposure Medium Total										0.0E+00					1.1E+01
Groundwater Total											0.0E+00					1.1E+01
										Total of Receptor Risks Across All Media	0.0E+00				Total of Receptor Hazards Across All Media	1.3E+01

Table 7.2.CTE Supplement A
Calculation of DAevent
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Chemical of Potential Concern	Water Concentration (CW) (μg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm²-event)	Eq
Benzene	1.00E+00	1.5E-02	5.1E-02	2.90E-01	7.0E-01	1.0E+00	0.33	1.3E-08	2
Bromomethane	2.00E+00	2.8E-03	1.1E-02	3.6E-01	8.7E-01	1.0E+00	0.33	5.4E-09	2
Antimony	1.82E+00	1.0E-03	NA	NA	NA	NA	0.33	6.0E-10	1
Arsenic	1.53E+00	1.0E-03	NA	NA	NA	NA	0.33	5.1E-10	1
Iron	3.94E+04	1.0E-03	NA	NA	NA	NA	0.33	1.3E-05	1
Manganese	2.36E+03	1.0E-03	NA	NA	NA	NA	0.33	7.8E-07	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm³ (eq 1)

Organics: DAevent (mg/cm2-event) =

$$\text{If } t_{event} \le t^*, \text{then } DA_{event} = 2 \times FA \times K_p \times C_w \sqrt{\frac{6 \times \tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} \ge t^*, \text{then } DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2 \times \tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Notes:
Permeability constants (Kp), B, lag time, and t* from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document. Calculated values described below.
Parameters B, tau, and t* were calculated for MTBE; dibenzofuran;1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene.
Source for Kp for these constituents is ORNL RAIS database (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml). Source for dibenzofuran Kp is the Region 9 PRG table.
NA - Not applicable.
tau - Lag time.
t* - Time to reach steady-state.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

Values for trans-1,2-Dichloroethene were used as surrogate for cis-1,2-dichloroethene.
Values for m-xylene were used as surrogate for total xylenes

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6}\right)$$

Where MW = Molecular weight and Kp = permeability constant. Values for both parameters were obtained from the RAIS database.

$$\tau_{event} = 0.105 \times 10^{(0.0056 MW)}$$

$$t^* = 2.4 \times \tau_{event}$$

If B < 0.6; used for dibenzofuran, MTBE, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.

$$t^* = 6 \times \tau_{event} \times \left(b - \sqrt{b^2 - c^2}\right)$$
$$b = \left(\frac{2(1+B)^2}{\pi} - c\right)$$
$$c = \left(\frac{1+3B+3B^2}{3 \times (1+B)}\right)$$

If B > 0.6 (not used; shown for informational purposes only.)

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	2.4E-01	mg/kg	1.0E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.5E-08	NA	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	9.9E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.2E-07	NA	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	1.2E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	8.9E-08	NA	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	5.8E-08	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.2E-07	NA	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	3.9E-03	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E+00	mg/kg/day	NA
				Antimony	1.9E+00	mg/kg	7.9E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-04	mg/kg/day	NA
				Arsenic	1.0E+01	mg/kg	4.4E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.5E-06	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Cadmium	4.9E+00	mg/kg	2.1E-06	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E-03	mg/kg/day	NA
				Chromium	2.8E+01	mg/kg	1.2E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-03	mg/kg/day	NA
				Copper	2.3E+02	mg/kg	9.8E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-02	mg/kg/day	NA
				Iron	2.5E+04	mg/kg	1.1E-02	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	2.8E+02	mg/kg	1.2E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.0E-02	mg/kg/day	NA
				Thallium	1.2E+00	mg/kg	5.2E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.0E-05	mg/kg/day	NA
				Vanadium	2.4E+01	mg/kg	1.0E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E-03	mg/kg/day	NA
			Exp. Route Total								7.8E-06					0.0E+00
			Dermal Absorption	Benzo(a)anthracene	2.4E-01	mg/kg	3.3E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.4E-07	NA	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	3.3E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.4E-06	NA	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	3.3E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	2.4E-07	NA	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	3.3E-07	mg/kg/day	7.3E+00	1/(mg/kg-day)	2.4E-06	NA	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.0E+00	mg/kg/day	NA
				Antimony	1.9E+00	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	6.0E-05	mg/kg/day	NA
				Arsenic	1.0E+01	mg/kg	7.6E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.1E-07	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Cadmium	4.9E+00	mg/kg	2.5E-09	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.5E-05	mg/kg/day	NA
				Chromium	2.8E+01	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.5E-05	mg/kg/day	NA
				Copper	2.3E+02	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-02	mg/kg/day	NA
				Iron	2.5E+04	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	2.8E+02	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	8.0E-04	mg/kg/day	NA
				Thallium	1.2E+00	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	7.0E-05	mg/kg/day	NA
				Vanadium	2.4E+01	mg/kg	2.5E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.6E-05	mg/kg/day	NA
			Exp. Route Total								5.4E-06					0.0E+00
		Exposure Point Total									1.3E-05					0.0E+00
	Exposure Medium Total										1.3E-05					0.0E+00
Soil* Total											1.3E-05					0.0E+00

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water	Ingestion	Benzene	1.0E+00	µg/L	5.3E-06	mg/kg/day	5.5E-02	1/(mg/kg-day)	2.9E-07	NA	mg/kg/day	4.0E-03	mg/kg/day	NA
				Bromomethane	2.0E+00	µg/L	1.1E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.4E-03	mg/kg/day	NA
				Antimony	1.8E+00	µg/L	9.7E-06	mg/kg/day	NA	NA	NA	NA	mg/kg/day	4.0E-04	mg/kg/day	NA
				Arsenic	1.5E+00	µg/L	8.1E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.2E-05	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Iron	3.9E+04	µg/L	2.1E-01	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	2.4E+03	µg/L	1.3E-02	mg/kg/day	NA	NA	NA	NA	mg/kg/day	2.0E-02	mg/kg/day	NA
			Exp. Route Total								1.3E-05					0.0E+00
			Dermal Absorption	Benzene	1.0E+00	µg/L	5.5E-07	mg/kg/day	5.5E-02	1/(mg/kg-day)	3.0E-08	NA	mg/kg/day	4.00E-03	mg/kg/day	NA
				Bromomethane	2.0E+00	µg/L	2.3E-07	mg/kg/day	NA	NA	NA	NA	mg/kg/day	1.4E-03	mg/kg/day	NA
				Antimony	1.8E+00	µg/L	2.4E-08	mg/kg/day	NA	NA	NA	NA	mg/kg/day	6.0E-05	mg/kg/day	NA
				Arsenic	1.5E+00	µg/L	2.0E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.1E-08	NA	mg/kg/day	3.0E-04	mg/kg/day	NA
				Iron	3.9E+04	µg/L	5.2E-04	mg/kg/day	NA	NA	NA	NA	mg/kg/day	3.0E-01	mg/kg/day	NA
				Manganese	2.4E+03	µg/L	3.1E-05	mg/kg/day	NA	NA	NA	NA	mg/kg/day	8.0E-04	mg/kg/day	NA
			Exp. Route Total								6.1E-08					0.0E+00
		Exposure Point Total									1.3E-05					0.0E+00
	Exposure Medium Total										1.3E-05					0.0E+00
Groundwater Total											1.3E-05					0.0E+00
										Total of Receptor Risks Across All Media	2.6E-05				Total of Receptor Hazards Across All Media	0.0E+00

TABLE 7.4.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EVALUATION

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Area B, Site 11 Soil*	Ingestion	Benzo(a)anthracene	2.4E-01	mg/kg	9.8E-09	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.1E-09	1.0E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	9.4E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	6.9E-08	1.0E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	1.2E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	8.5E-09	1.2E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	5.5E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.0E-08	5.8E-08	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	3.7E-04	mg/kg/day	NA	NA	NA	3.9E-03	mg/kg/day	1.0E+00	mg/kg/day	3.9E-03
				Antimony	1.9E+00	mg/kg	7.5E-08	mg/kg/day	NA	NA	NA	8.0E-07	mg/kg/day	4.0E-04	mg/kg/day	2.0E-03
				Arsenic	1.0E+01	mg/kg	4.1E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.2E-07	4.4E-06	mg/kg/day	3.0E-04	mg/kg/day	1.5E-02
				Cadmium	4.9E+00	mg/kg	2.0E-07	mg/kg/day	NA	NA	NA	2.1E-06	mg/kg/day	1.0E-03	mg/kg/day	2.1E-03
				Chromium	2.8E+01	mg/kg	1.1E-06	mg/kg/day	NA	NA	NA	1.2E-05	mg/kg/day	3.0E-03	mg/kg/day	3.9E-03
				Copper	2.3E+02	mg/kg	9.3E-06	mg/kg/day	NA	CTE	NA	9.9E-05	mg/kg/day	4.0E-02	mg/kg/day	2.5E-03
				Iron	2.5E+04	mg/kg	1.0E-03	mg/kg/day	NA	NA	NA	1.1E-02	mg/kg/day	3.0E-01	mg/kg/day	3.5E-02
				Manganese	2.8E+02	mg/kg	1.1E-05	mg/kg/day	NA	NA	NA	1.2E-04	mg/kg/day	2.0E-02	mg/kg/day	6.0E-03
				Thallium	1.2E+00	mg/kg	4.9E-08	mg/kg/day	NA	NA	NA	5.2E-07	mg/kg/day	7.0E-05	mg/kg/day	7.5E-03
				Vanadium	2.4E+01	mg/kg	9.7E-07	mg/kg/day	NA	NA	NA	1.0E-05	mg/kg/day	1.0E-03	mg/kg/day	1.0E-02
			Exp. Route Total								7.4E-07					8.8E-02
			Dermal Absorption	Benzo(a)anthracene	2.4E-01	mg/kg	1.0E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	7.4E-09	1.1E-07	mg/kg/day	NA	NA	NA
				Benzo(a)pyrene	2.3E-01	mg/kg	9.8E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	7.1E-08	1.0E-07	mg/kg/day	NA	NA	NA
				Benzo(b)fluoranthene	2.9E-01	mg/kg	1.2E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	8.8E-09	1.3E-07	mg/kg/day	NA	NA	NA
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	5.7E-09	mg/kg/day	7.3E+00	1/(mg/kg-day)	4.2E-08	6.0E-08	mg/kg/day	NA	NA	NA
				Aluminum	9.2E+03	mg/kg	3.0E-05	mg/kg/day	NA	NA	NA	3.2E-04	mg/kg/day	1.0E+00	mg/kg/day	3.2E-04
				Antimony	1.9E+00	mg/kg	6.0E-09	mg/kg/day	NA	NA	NA	6.4E-08	mg/kg/day	6.0E-05	mg/kg/day	1.1E-03
				Arsenic	1.0E+01	mg/kg	9.9E-08	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.5E-07	1.1E-06	mg/kg/day	3.0E-04	mg/kg/day	3.5E-03
				Cadmium	4.9E+00	mg/kg	1.6E-09	mg/kg/day	NA	NA	NA	1.7E-08	mg/kg/day	2.5E-05	mg/kg/day	6.7E-04
				Chromium	2.8E+01	mg/kg	8.9E-08	mg/kg/day	NA	NA	NA	9.5E-07	mg/kg/day	7.5E-05	mg/kg/day	1.3E-02
				Copper	2.3E+02	mg/kg	7.4E-07	mg/kg/day	NA	NA	NA	7.9E-06	mg/kg/day	4.0E-02	mg/kg/day	2.0E-04
				Iron	2.5E+04	mg/kg	8.0E-05	mg/kg/day	NA	NA	NA	8.5E-04	mg/kg/day	3.0E-01	mg/kg/day	2.8E-03
				Manganese	2.8E+02	mg/kg	9.1E-07	mg/kg/day	NA	NA	NA	9.6E-06	mg/kg/day	8.0E-04	mg/kg/day	1.2E-02
				Thallium	1.2E+00	mg/kg	3.9E-09	mg/kg/day	NA	NA	NA	4.2E-08	mg/kg/day	7.0E-05	mg/kg/day	6.0E-04
				Vanadium	2.4E+01	mg/kg	7.8E-08	mg/kg/day	NA	NA	NA	8.3E-07	mg/kg/day	2.6E-05	mg/kg/day	3.2E-02
			Exp. Route Total								2.8E-07					6.6E-02
		Exposure Point Total									1.0E-06					1.5E-01
	Exposure Medium Total										1.0E-06					1.5E-01
Soil* Total											1.0E-06					1.5E-01
							Total of Receptor Risks Across All Media				1.0E-06	Total of Receptor Hazards Across All Media				1.5E-01

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Benzo(a)pyrene	7.5E-08	NA	3.9E-08	1.1E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	4.4E-08	NA	2.3E-08	6.6E-08	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	3.5E-03	NA	1.4E-04	3.7E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	3.3E-03	NA	8.9E-04	4.2E-03
			Arsenic	9.1E-07	NA	1.1E-07	1.0E-06	Skin, Vascular	1.6E-02	NA	1.9E-03	1.8E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	5.7E-03	NA	9.1E-04	6.6E-03
			Chromium	NA	NA	NA	0.0E+00	Not identified	8.3E-03	NA	1.3E-02	2.2E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	5.1E-03	NA	2.1E-04	5.4E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	7.3E-02	NA	2.9E-03	7.6E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	6.9E-03	NA	6.9E-03	1.4E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	2.1E-02	NA	8.3E-04	2.2E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	7.4E-03	NA	1.1E-02	1.9E-02
Chemical Total				1.0E-06	NA	1.7E-07	1.2E-06		1.5E-01	NA	3.9E-02	1.9E-01
Medium Total							1.2E-06					1.9E-01
Receptor Total							1.2E-06				Receptor HI Total	1.9E-01

Total Skin HI Across All Media =	1.8E-02
Total Vascular HI Across All Media =	1.8E-02
Total Gastrointestinal HI Across All Media =	8.2E-02
Total Blood HI Across All Media =	1.0E-01
Total Liver HI Across All Media =	9.8E-02
Total Hair HI Across All Media =	2.2E-02
Total CNS/Neurological HI Across All Media =	1.8E-02
Total Kidney HI Across All Media =	2.5E-02
Total "Not identified" HI Across All Media =	2.2E-02

Notes:

CNS = Central Nervous System

NA = Not available/not applicable

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Benzo(a)pyrene	1.5E-07	NA	7.5E-08	2.2E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	8.5E-08	NA	4.4E-08	1.3E-07	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	2.6E-03	NA	1.0E-04	2.7E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	2.4E-03	NA	6.4E-04	3.1E-03
			Arsenic	1.8E-06	NA	2.1E-07	2.0E-06	Skin, Vascular	1.2E-02	NA	1.4E-03	1.3E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	4.2E-03	NA	6.6E-04	4.8E-03
			Chromium	NA	NA	NA	0.0E+00	Not identified	6.0E-03	NA	9.6E-03	1.6E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	3.7E-03	NA	1.5E-04	3.9E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	5.4E-02	NA	2.1E-03	5.6E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	5.0E-03	NA	5.0E-03	1.0E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.5E-02	NA	6.0E-04	1.6E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	5.4E-03	NA	8.2E-03	1.4E-02
Chemical Total				2.0E-06	NA	3.3E-07	2.3E-06		1.1E-01	NA	2.9E-02	1.4E-01
Medium Total							2.3E-06					1.4E-01
Receptor Total							2.3E-06				Receptor HI Total	1.4E-01

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Skin HI Across All Media =	1.3E-02
Total Vascular HI Across All Media =	1.3E-02
Total Gastrointestinal HI Across All Media =	6.0E-02
Total Blood HI Across All Media =	7.4E-02
Total Liver HI Across All Media =	7.1E-02
Total Hair HI Across All Media =	1.6E-02
Total CNS/Neurological HI Across All Media =	1.3E-02
Total Kidney HI Across All Media =	1.8E-02
Total "Not identified" HI Across All Media =	1.6E-02

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Current
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Area B, Site 11 Surface Soil	Benzo(a)pyrene	7.3E-07	NA	6.2E-07	1.3E-06	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	4.2E-07	NA	3.6E-07	7.9E-07	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	1.2E-02	NA	8.2E-04	1.3E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	1.2E-02	NA	5.1E-03	1.7E-02
			Arsenic	8.9E-06	NA	1.8E-06	1.1E-05	Skin, Vascular	5.5E-02	NA	1.1E-02	6.6E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.0E-02	NA	5.3E-03	2.5E-02
			Chromium	NA	NA	NA	0.0E+00	Not identified	2.9E-02	NA	7.7E-02	1.1E-01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.8E-02	NA	1.2E-03	1.9E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	2.6E-01	NA	1.7E-02	2.7E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	2.4E-02	NA	4.0E-02	6.4E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.3E-02	NA	4.8E-03	7.7E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	2.6E-02	NA	6.5E-02	9.1E-02
Chemical Total				1.0E-05	NA	2.7E-06	1.3E-05		5.3E-01	NA	2.3E-01	7.5E-01
Medium Total							1.3E-05					7.5E-01
Receptor Total							1.3E-05				Receptor HI Total	7.5E-01

Notes:
NA = Not available/not applicable

Total Skin HI Across All Media =	6.6E-02
Total Vascular HI Across All Media =	6.6E-02
Total Gastrointestinal HI Across All Media =	2.9E-01
Total Blood HI Across All Media =	3.7E-01
Total Liver HI Across All Media =	3.5E-01
Total Hair HI Across All Media =	7.7E-02
Total CNS/Neurological HI Across All Media =	7.7E-02
Total Kidney HI Across All Media =	1.2E-01
Total "Not identified" HI Across All Media =	1.1E-01

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	1.0E-08	NA	1.8E-09	1.2E-08	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	8.0E-08	NA	1.4E-08	9.4E-08	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	1.0E-08	NA	1.9E-09	1.2E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	5.6E-08	NA	1.0E-08	6.6E-08	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	2.5E-02	NA	3.5E-04	2.6E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	8.6E-02	NA	7.9E-03	9.4E-02
			Arsenic	7.8E-07	NA	3.2E-08	8.1E-07	Skin, Vascular	1.2E-01	NA	5.0E-03	1.3E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.5E-02	NA	1.4E-03	2.6E-02
			Chromium	NA	NA	NA	0.0E+00	Not identified	6.9E-03	NA	3.8E-03	1.1E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.7E-02	NA	3.8E-04	2.8E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	2.7E-01	NA	3.7E-03	2.7E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	4.6E-02	NA	1.6E-02	6.2E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.7E-01	NA	2.4E-03	1.8E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	8.7E-03	NA	4.6E-03	1.3E-02
Chemical Total				9.3E-07	NA	6.0E-08	9.9E-07		7.9E-01	NA	4.5E-02	8.3E-01
Medium Total							9.9E-07					8.3E-01
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer	Benzene	NA	NA	2.8E-09	2.8E-09	Blood	NA	NA	1.2E-03	1.2E-03
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	1.0E-03	1.0E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	2.3E-02	2.3E-02
			Arsenic	NA	NA	1.5E-08	1.5E-08	Skin, Vascular	NA	NA	2.3E-03	2.3E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	NA	NA	3.5E-02	3.5E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	8.9E-01	8.9E-01
Chemical Total				0.0E+00	NA	1.7E-08	1.7E-08		NA	NA	9.5E-01	9.5E-01

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 - Volatilization from Shallow Aquifer	Benzene	NA	3.1E-09	NA	3.1E-09	Blood	NA	4.4E-04	NA	4.4E-04
			Bromomethane	NA	NA	NA	0.0E+00	Nasal mucosa	NA	9.6E-03	NA	9.6E-03
Chemical Total				NA	3.1E-09	NA	3.1E-09		NA	1.0E-02	NA	1.0E-02
Medium Total							2.1E-08					9.6E-01
Receptor Total							1.0E-06				Receptor HI Total	1.8E+00

Total Skin HI Across All Media =	1.3E-01
Total Vascular HI Across All Media =	1.3E-01
Total Gastrointestinal HI Across All Media =	3.4E-01
Total Blood HI Across All Media =	6.0E-01
Total Liver HI Across All Media =	4.8E-01
Total Hair HI Across All Media =	1.8E-01
Total CNS/Neurological HI Across All Media =	9.7E-01
Total Kidney HI Across All Media =	4.0E-02
Total "Not identified" HI Across All Media =	1.1E-02
Total Nasal HI Across All Media =	9.6E-03

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	1.5E-02	NA	5.9E-04	1.5E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	2.5E-02	NA	6.6E-03	3.2E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	7.0E-02	NA	8.4E-03	7.9E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	1.5E-02	NA	2.3E-03	1.7E-02
			Chromium	NA	NA	NA	0.0E+00	Not identified	2.7E-02	NA	4.3E-02	6.9E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.6E-02	NA	6.4E-04	1.7E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.6E-01	NA	6.2E-03	1.6E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	2.7E-02	NA	2.7E-02	5.4E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.0E-01	NA	4.1E-03	1.1E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	3.6E-02	NA	5.5E-02	9.0E-02
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		4.9E-01	NA	1.5E-01	6.4E-01
Medium Total							0.0E+00					6.4E-01
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	6.8E-03	NA	1.0E-03	7.9E-03
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	3.9E-02	NA	1.3E-03	4.0E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	2.0E-01	NA	6.9E-03	2.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.6E-01	NA	1.4E-03	2.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	4.1E+00	NA	2.1E-02	4.1E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	4.1E+00	NA	5.4E-01	4.7E+00
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		8.7E+00	NA	5.7E-01	9.3E+00

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Water Vapors at Showerhead	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	NA	2.9E-03	NA	2.9E-03
			Bromomethane	NA	NA	NA	0.0E+00	Nasal mucosa	NA	3.2E-02	NA	3.2E-02
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		NA	3.5E-02	NA	3.5E-02
Medium Total							0.0E+00					9.3E+00
Receptor Total							0.0E+00				Receptor HI Total	1.0E+01

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Skin HI Across All Media =	3.5E-01
Total Vascular HI Across All Media =	3.5E-01
Total Gastrointestinal HI Across All Media =	4.3E+00
Total Blood HI Across All Media =	4.6E+00
Total Liver HI Across All Media =	4.4E+00
Total Hair HI Across All Media =	1.1E-01
Total CNS/Neurological HI Across All Media =	4.7E+00
Total Kidney HI Across All Media =	1.1E-01
Total "Not identified" HI Across All Media =	6.9E-02
Total Nasal HI Across All Media =	3.2E-02
Total Immune System HI Across All Media =	1.1E-02

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	1.4E-01	NA	3.9E-03	1.4E-01
			Antimony	NA	NA	NA	0.0E+00	Blood	2.3E-01	NA	4.4E-02	2.8E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.6E-01	NA	5.5E-02	7.1E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	1.4E-01	NA	1.5E-02	1.5E-01
			Chromium	NA	NA	NA	0.0E+00	Not identified	2.5E-01	NA	2.8E-01	5.3E-01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	4.2E-03	1.5E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.5E+00	NA	4.1E-02	1.5E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	2.5E-01	NA	1.8E-01	4.3E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	9.5E-01	NA	2.7E-02	9.8E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	3.3E-01	NA	3.6E-01	6.9E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		4.6E+00	NA	1.0E+00	5.6E+00
Medium Total							0.0E+00					5.6E+00

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	1.6E-02	NA	2.5E-03	1.8E-02
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	9.1E-02	NA	2.9E-03	9.4E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	4.6E-01	NA	2.0E-02	4.8E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.2E-01	NA	4.1E-03	6.2E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	9.5E+00	NA	6.3E-02	9.6E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	9.7E+00	NA	1.6E+00	1.1E+01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		2.0E+01	NA	1.7E+00	2.2E+01
Medium Total							0.0E+00					2.2E+01
Receptor Total							0.0E+00				Receptor HI Total	2.8E+01

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Skin HI Across All Media =	1.3E+00
Total Vascular HI Across All Media =	1.3E+00
Total Gastrointestinal HI Across All Media =	1.1E+01
Total Blood HI Across All Media =	1.3E+01
Total Liver HI Across All Media =	1.2E+01
Total Hair HI Across All Media =	9.8E-01
Total CNS/Neurological HI Across All Media =	1.2E+01
Total Kidney HI Across All Media =	8.4E-01
Total "Not identified" HI Across All Media =	5.3E-01
Total Immune System HI Across All Media =	1.8E-02

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	4.7E-07	NA	1.9E-07	6.6E-07	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	3.7E-06	NA	1.5E-06	5.3E-06	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	4.8E-07	NA	2.0E-07	6.8E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	2.6E-06	NA	1.1E-06	3.7E-06	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	3.6E-05	NA	3.4E-06	4.0E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Cadmium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	NA	NA	NA	0.0E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
Chemical Total				4.4E-05	NA	6.4E-06	5.0E-05		NA	NA	NA	0.0E+00
Medium Total							5.0E-05					0.0E+00
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	8.2E-07	NA	1.3E-07	9.5E-07	Blood, Immune	NA	NA	NA	0.0E+00
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	6.5E-05	NA	3.7E-07	6.5E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
Chemical Total				6.6E-05	NA	5.0E-07	6.6E-05		NA	NA	NA	0.0E+00

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Water Vapors at Showerhead	Benzene	NA	2.4E-07	NA	2.4E-07	Blood, Immune	NA	NA	NA	0.0E+00
			Bromomethane	NA	NA	NA	0.0E+00	Nasal mucosa	NA	NA	NA	0.0E+00
Chemical Total				NA	2.4E-07	NA	2.4E-07		NA	NA	NA	0.0E+00
Medium Total							6.6E-05					0.0E+00
Receptor Total							1.2E-04				Receptor HI Total	0.0E+00

Notes:

CNS = Central Nervous System

NA = Not available/not applicable

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	1.1E-07	NA	9.0E-08	2.0E-07	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	8.3E-07	NA	7.1E-07	1.5E-06	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	1.1E-07	NA	9.3E-08	2.0E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	5.8E-07	NA	5.0E-07	1.1E-06	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	1.1E-02	NA	7.0E-04	1.1E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	1.8E-02	NA	7.9E-03	2.6E-02
			Arsenic	8.1E-06	NA	1.6E-06	9.7E-06	Skin, Vascular	5.0E-02	NA	1.0E-02	6.0E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	1.0E-02	NA	2.8E-03	1.3E-02
			Chromium	NA	NA	NA	0.0E+00	Not identified	1.9E-02	NA	5.0E-02	7.0E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.1E-02	NA	7.5E-04	1.2E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.1E-01	NA	7.4E-03	1.2E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.9E-02	NA	3.2E-02	5.1E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.3E-02	NA	4.8E-03	7.7E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	2.5E-02	NA	6.5E-02	9.0E-02
Chemical Total				9.7E-06	NA	3.0E-06	1.3E-05		3.5E-01	NA	1.8E-01	5.3E-01
Medium Total							1.3E-05					5.3E-01
Receptor Total							1.3E-05				Receptor HI Total	5.3E-01

Notes:
NA = Not available/not applicable

Total Skin HI Across All Media =	6.0E-02
Total Vascular HI Across All Media =	6.0E-02
Total Gastrointestinal HI Across All Media =	1.3E-01
Total Blood HI Across All Media =	2.2E-01
Total Liver HI Across All Media =	2.0E-01
Total Hair HI Across All Media =	7.7E-02
Total CNS/Neurological HI Across All Media =	6.2E-02
Total Kidney HI Across All Media =	1.0E-01
Total "Not identified" HI Across All Media =	7.0E-02

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	4.2E-03	NA	3.4E-04	4.5E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	2.1E-03	NA	1.1E-03	3.3E-03
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.6E-02	NA	3.7E-03	1.9E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.2E-03	NA	7.1E-04	2.9E-03
			Chromium	NA	NA	NA	0.0E+00	Not identified	4.2E-03	NA	1.3E-02	1.8E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.6E-03	NA	2.1E-04	2.8E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	3.8E-02	NA	3.0E-03	4.1E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	6.4E-03	NA	1.3E-02	1.9E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	8.0E-03	NA	6.4E-04	8.6E-03
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.1E-02	NA	3.4E-02	4.5E-02
Chemical Total				NA	NA	NA	0.0E+00		9.4E-02	NA	7.0E-02	1.6E-01
Medium Total							0.0E+00					1.6E-01

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	3.2E-03	NA	4.6E-04	3.7E-03
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	1.8E-02	NA	5.6E-04	1.9E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	5.8E-02	NA	1.2E-03	5.9E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.6E-02	NA	2.1E-04	6.6E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.7E+00	NA	5.4E-03	1.7E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	1.5E+00	NA	1.2E-01	1.6E+00
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		3.3E+00	NA	1.3E-01	3.5E+00
Medium Total							0.0E+00					3.5E+00
Receptor Total							0.0E+00				Receptor HI Total	3.6E+00

Notes:

CNS = Central Nervous System

NA = Not available/not applicable

Total Skin HI Across All Media =	8.5E-02
Total Vascular HI Across All Media =	8.5E-02
Total Gastrointestinal HI Across All Media =	1.8E+00
Total Blood HI Across All Media =	1.8E+00
Total Liver HI Across All Media =	1.7E+00
Total Hair HI Across All Media =	8.6E-03
Total CNS/Neurological HI Across All Media =	1.7E+00
Total Kidney HI Across All Media =	4.8E-02
Total "Not identified" HI Across All Media =	1.8E-02
Total Immune System HI Across All Media =	3.7E-03

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	3.9E-02	NA	2.2E-03	4.2E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	2.0E-02	NA	7.4E-03	2.7E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.5E-01	NA	2.5E-02	1.7E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.1E-02	NA	4.7E-03	2.6E-02
			Chromium	NA	NA	NA	0.0E+00	Not identified	3.9E-02	NA	8.8E-02	1.3E-01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.5E-02	NA	1.4E-03	2.6E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	3.5E-01	NA	2.0E-02	3.7E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	6.0E-02	NA	8.4E-02	1.4E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.4E-02	NA	4.2E-03	7.9E-02
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.0E-01	NA	2.2E-01	3.2E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		8.8E-01	NA	4.6E-01	1.3E+00
Medium Total							0.0E+00					1.3E+00

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	NA	NA	NA	0.0E+00	Blood, Immune	1.1E-02	NA	9.0E-04	1.2E-02
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	6.1E-02	NA	1.1E-03	6.2E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	1.9E-01	NA	2.8E-03	2.0E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.2E-01	NA	4.8E-04	2.2E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	5.6E+00	NA	1.2E-02	5.6E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	5.0E+00	NA	2.7E-01	5.3E+00
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		1.1E+01	NA	2.9E-01	1.1E+01
Medium Total							0.0E+00					1.1E+01
Receptor Total							0.0E+00				Receptor HI Total	1.3E+01

Notes:

CNS = Central Nervous System

NA = Not available/not applicable

Total Skin HI Across All Media =	3.9E-01
Total Vascular HI Across All Media =	3.9E-01
Total Gastrointestinal HI Across All Media =	6.1E+00
Total Blood HI Across All Media =	6.3E+00
Total Liver HI Across All Media =	6.1E+00
Total Hair HI Across All Media =	7.9E-02
Total CNS/Neurological HI Across All Media =	5.5E+00
Total Kidney HI Across All Media =	3.5E-01
Total "Not identified" HI Across All Media =	1.3E-01
Total Immune System HI Across All Media =	1.2E-02

TABLE 9.3.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	7.5E-08	NA	2.4E-07	3.1E-07	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	7.2E-07	NA	2.4E-06	3.1E-06	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	8.9E-08	NA	2.4E-07	3.3E-07	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	4.2E-07	NA	2.4E-06	2.8E-06	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	6.5E-06	NA	1.1E-07	6.6E-06	Skin, Vascular	NA	NA	NA	0.0E+00
			Cadmium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chromium	NA	NA	NA	0.0E+00	Not identified	NA	NA	NA	0.0E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
Chemical Total				7.8E-06	NA	5.4E-06	1.3E-05		NA	NA	NA	0.0E+00
Medium Total							1.3E-05					0.0E+00
Groundwater	Groundwater	Area B, Site 11 - Shallow Aquifer - Tap Water	Benzene	2.9E-07	NA	3.0E-08	3.2E-07	Blood, Immune	NA	NA	NA	0.0E+00
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	1.2E-05	NA	3.1E-08	1.2E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
Chemical Total				1.3E-05	NA	6.1E-08	1.3E-05		NA	NA	NA	0.0E+00
Medium Total							1.3E-05					0.0E+00
Receptor Total							2.6E-05				Receptor HI Total	0.0E+00

TABLE 9.4.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 11 Feasibility Study

NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*	Benzo(a)anthracene	7.1E-09	NA	7.4E-09	1.5E-08	NA	NA	NA	NA	0.0E+00
			Benzo(a)pyrene	6.9E-08	NA	7.1E-08	1.4E-07	NA	NA	NA	NA	0.0E+00
			Benzo(b)fluoranthene	8.5E-09	NA	8.8E-09	1.7E-08	NA	NA	NA	NA	0.0E+00
			Dibenz(a,h)anthracene	4.0E-08	NA	4.2E-08	8.2E-08	NA	NA	NA	NA	0.0E+00
			Aluminum	NA	NA	NA	0.0E+00	Neurological	3.9E-03	NA	3.2E-04	4.3E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	2.0E-03	NA	1.1E-03	3.1E-03
			Arsenic	6.2E-07	NA	1.5E-07	7.7E-07	Skin, Vascular	1.5E-02	NA	3.5E-03	1.8E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.1E-03	NA	6.7E-04	2.8E-03
			Chromium	NA	NA	NA	0.0E+00	Not identified	3.9E-03	NA	1.3E-02	1.7E-02
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.5E-03	NA	2.0E-04	2.7E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	3.5E-02	NA	2.8E-03	3.8E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	6.0E-03	NA	1.2E-02	1.8E-02
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.5E-03	NA	6.0E-04	8.1E-03
			Vanadium	NA	NA	NA	0.0E+00	Kidney	1.0E-02	NA	3.2E-02	4.2E-02
Chemical Total				7.4E-07	NA	2.8E-07	1.0E-06		8.8E-02	NA	6.6E-02	1.5E-01
Medium Total							1.0E-06					1.5E-01
Receptor Total							1.0E-06				Receptor HI Total	1.5E-01

Notes:

CNS = Central Nervous System

NA = Not available/not applicable

Total Skin HI Across All Media =	1.8E-02
Total Vascular HI Across All Media =	1.8E-02
Total Gastrointestinal HI Across All Media =	4.1E-02
Total Blood HI Across All Media =	4.9E-02
Total Liver HI Across All Media =	4.6E-02
Total Hair HI Across All Media =	8.1E-03
Total CNS/Neurological HI Across All Media =	2.2E-02
Total Kidney HI Across All Media =	4.5E-02
Total "Not identified" HI Across All Media =	1.7E-02

TABLE 10.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*										
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	2.7E-01	NA	3.7E-03	2.7E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.7E-01	NA	2.4E-03	1.8E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		4.4E-01	NA	6.1E-03	4.5E-01
Medium Total							0.0E+00					4.5E-01
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer										
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	8.9E-01	8.9E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		NA	NA	8.9E-01	8.9E-01
Medium Total							0.0E+00					8.9E-01
Receptor Total							0.0E+00				Receptor HI Total	1.3E+00

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Gastrointestinal HI Across All Media =	2.7E-01
Total Blood HI Across All Media =	4.5E-01
Total Liver HI Across All Media =	4.5E-01
Total CNS/Neurological HI Across All Media =	8.9E-01
Total Hair HI Across All Media =	1.8E-01

TABLE 10.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*										
			Chromium	NA	NA	NA	0.0E+00	Not identified	2.7E-02	NA	4.3E-02	6.9E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.6E-01	NA	6.2E-03	1.6E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.0E-01	NA	4.1E-03	1.1E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		2.8E-01	NA	5.3E-02	3.4E-01
Medium Total							0.0E+00					3.4E-01
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water										
			Antimony	NA	NA	NA	0.0E+00	Blood	2.0E-01	NA	6.9E-03	2.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	2.6E-01	NA	1.4E-03	2.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	4.1E+00	NA	2.1E-02	4.1E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	5.9E-01	NA	5.4E-01	1.1E+00
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		5.1E+00	NA	5.7E-01	5.7E+00
Medium Total							0.0E+00					5.7E+00
Receptor Total							0.0E+00				Receptor HI Total	6.0E+00

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Skin HI Across All Media =	2.7E-01
Total Vascular HI Across All Media =	2.7E-01
Total Gastrointestinal HI Across All Media =	4.3E+00
Total Blood HI Across All Media =	4.6E+00
Total Liver HI Across All Media =	4.4E+00
Total Hair HI Across All Media =	1.1E-01
Total CNS/Neurological HI Across All Media =	1.1E+00
Total Kidney HI Across All Media =	0.0E+00
Total "Not identified" HI Across All Media =	6.9E-02

TABLE 10.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*										
			Aluminum	NA	NA	NA	0.0E+00	Neurological	1.4E-01	NA	3.9E-03	1.4E-01
			Antimony	NA	NA	NA	0.0E+00	Blood	2.3E-01	NA	4.4E-02	2.8E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.6E-01	NA	5.5E-02	7.1E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	1.4E-01	NA	1.5E-02	1.5E-01
			Chromium	NA	NA	NA	0.0E+00	Not identified	2.5E-01	NA	2.8E-01	5.3E-01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	4.2E-03	1.5E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.5E+00	NA	4.1E-02	1.5E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	2.5E-01	NA	1.8E-01	4.3E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	9.5E-01	NA	2.7E-02	9.8E-01
			Vanadium	NA	NA	NA	0.0E+00	Kidney	3.3E-01	NA	3.6E-01	6.9E-01
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		4.6E+00	NA	1.0E+00	5.6E+00
Medium Total							0.0E+00					5.6E+00
Groundwater	Groundwater	Area B, Site 11 Shallow Aquifer - Tap Water										
			Benzene	NA	NA	NA	0.0E+00	Blood, Immune	1.6E-02	NA	2.5E-03	1.8E-02
			Bromomethane	NA	NA	NA	0.0E+00	Gastrointestinal	9.1E-02	NA	2.9E-03	9.4E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	4.6E-01	NA	2.0E-02	4.8E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.2E-01	NA	4.1E-03	6.2E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	9.5E+00	NA	6.3E-02	9.6E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	1.4E+00	NA	1.6E+00	3.0E+00
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		1.2E+01	NA	1.7E+00	1.4E+01
Medium Total							0.0E+00					1.4E+01
Receptor Total							0.0E+00				Receptor HI Total	1.9E+01

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Skin HI Across All Media =	1.3E+00
Total Vascular HI Across All Media =	1.3E+00
Total Gastrointestinal HI Across All Media =	1.1E+01
Total Blood HI Across All Media =	1.3E+01
Total Liver HI Across All Media =	1.2E+01
Total Hair HI Across All Media =	9.8E-01

TABLE 10.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
											Total CNS/Neurological HI Across All Media =	3.5E+00
											Total Kidney HI Across All Media =	8.4E-01
											Total "Not identified" HI Across All Media =	5.3E-01
											Total Immune System HI Across All Media =	1.8E-02

TABLE 10.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Site 11 Feasibility Study
NDWIH, Indian Head, Maryland

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Area B, Site 11 Soil*										
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal, Blood, Liver	1.1E-01	NA	7.4E-03	1.2E-01
			Thallium	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.3E-02	NA	4.8E-03	7.7E-02
Chemical Total				0.0E+00	NA	0.0E+00	0.0E+00		1.8E-01	NA	1.2E-02	2.0E-01
Medium Total							0.0E+00					2.0E-01
Receptor Total							0.0E+00				Receptor HI Total	2.0E-01

Notes:
CNS = Central Nervous System
NA = Not available/not applicable

Total Gastrointestinal HI Across All Media =	1.2E-01
Total Blood HI Across All Media =	2.0E-01
Total Liver HI Across All Media =	2.0E-01
Total Hair HI Across All Media =	7.7E-02

Appendix G
Technical Memorandum – Preliminary Remediation Goal for Zinc – Sediments at Site 11

Preliminary Remedial Goal for Zinc - Sediments at Site 11, NDWIH

PREPARED FOR: Gunarti Coglan/WDC

PREPARED BY: John Burgess/BOS

COPIES: Margaret Kasim/WDC
Laurie Aldape/WDC
Gene Peters/WDC

DATE: February 24, 2005

This memorandum describes the rationale supporting the derivation of the preliminary remedial goal (PRG) for the shoreline sediments at Site 11, NDWIH. The results of the baseline ecological risk assessment (BERA) demonstrated that zinc in the sediments at Site 11 is bioaccumulating in the tissues of small fish inhabiting the shoreline area. The concentration of zinc found in the fish tissue poses a potentially unacceptable to at least one fish species. The BERA results demonstrated that the benthic invertebrate community is relatively healthy 20-30 ft offshore and not adversely affected by site-related chemicals. However, the zinc concentrations in the BERA samples (collected 20-30 ft offshore in 2004) were 60-90% lower in zinc concentrations than the samples collected along the immediate shoreline in 2000. The samples collected for the BERA contained an average of 200 mg/kg zinc, in contrast to the samples collected in 2000, which contained an average of 847 mg/kg zinc. This difference is likely related to the abundant metal debris found along the shoreline.

Sample	Shoreline Samples (2000) mg/kg	Off-shore Samples (2004) mg/kg
IS11SD07*	800	135
IS11SD06*	147	-
IS11SD05*	258	102
IS11SD04	1,910	218
IS11SD03	898	370
IS11SD02	847	287
IS11SD01	1,310	-
IS11SD08	514	-
IS17SD06	939	90.6
Average	847	200
Overall Average	588	

* Unnamed creek sample

In order to derive a PRG for zinc, the concentrations of all the sediment samples collected from Site 11 (including IS17SD06, which should be associated with Site 11 given its location) were averaged to calculate a site-specific bioconcentration factor (BCF) based on an overall average zinc concentration of 588 mg/kg at Site 11.

Fish Species	Tissue (mg/kg, wet)	BCF (dry sediment to wet fish tissue)
Fundulus heteroclitus	35.4	0.0602
Notropis sp.	51.7*	0.0879

* Exceeds critical residue value of 40 mg/kg

The site-specific BCF for *Notropis sp*. was used to back-calculate a critical zinc concentration for sediment that would theoretically result in fish tissue levels equivalent to the literature-based critical residue value (CRV) of 40 mg/kg, which is a chronic lowest observed adverse effect value (LOAEL) for flagfish (*Jordanella floridae*). The site-specific BCF for *Notropis sp*. was also used to back-calculate a critical zinc concentration for sediment that would theoretically result in fish tissue levels equivalent to background tissue values reported for two fish species (golden shiner and spottail shiner) in Mattawoman Creek (TetraTech NUS, 2002).

Criteria	Tissue Concentration (mg/kg)	Critical Sediment Concentration (mg/kg)
Critical Residue Value	40	455
Background Fish Tissue	35	398

Considering these calculations, if a PRG of 450 mg/kg were implemented along the shoreline of Site 11 (excluding IS11SD07 in the unnamed creek), the resulting post-remedial average sediment concentration would be about 341 mg/kg.

Sample	Shoreline Samples (2000) mg/kg	Off-shore Samples (2004) mg/kg
IS11SD07*	800	135
IS11SD06*	147	-
IS11SD05*	258	102
IS11SD04	**450**	218
IS11SD03	**450**	370
IS11SD02	**450**	287
IS11SD01	**450**	-
IS11SD08	**450**	-
IS17SD06	**450**	90.6
Overall Average	341	

* Unnamed creek sample

Bold type indicates reduced concentration post-remediation

A post-remedial average concentration of 341 mg/kg would result in a theoretical fish tissue concentration of 30 mg/kg, which is below both the literature-based CRV for zinc and the background fish tissue concentration. A value of 450 mg/kg would also contribute to restoring a healthy benthic invertebrate community along the shoreline of Site 11. The consensus-based probable effect concentration (PEC) for zinc is 459 mg/kg (MacDonald et al. 2000). This was the criteria used in the BERA to evaluate the sediment chemistry results and represents a value that is intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are expected to occur frequently. Thus, a PRG of 450 mg/kg would adequately protect both fish and benthic invertebrates from excess zinc in the shoreline sediments at Site 11.

References

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicology*. 39, 20-31.

TetraTech NUS. 2002. *Mattawoman Creek Study*. Indian Head Division, Naval Surface Warfare Center, Indian Head, Maryland. Vols. I and II. Engineering Field Activity, Chesapeake, Naval Facilities Engineering Command.

Appendix H
IHIRT Conference Call Minutes

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To: Dennis Orenshaw/EPA
Curtis DeTore/MDE
Margaret Kasim/CH2M HILL
Jeff Morris/NAVFAC Washington
Joe Rail/NAVFAC Washington
Scott Saroff/CH2M HILL
Gunarti Coghlan/CH2M HILL

Phone No.:

Date: October 6, 2005

Call From:

Time: 02:00 – 03:00 PM

Message Taken By: CH2M HILL

Subject: Extent of Solid Waste at Site 11, NDWIH, Indian Head, Maryland

The conference call was hosted by CH2M HILL to clarify and identify the extent of solid waste requiring remediation at Site 11.

Below is a summary of the discussion points:

1. CH2M HILL presented the findings (refer to Attachment 1 for the Technical Memorandum) based on review of soil description of borings in Area B at Site 11. The review of the description of soil borings in Area B indicate that wood, bricks, concrete, and pieces of plastic were encountered at some locations, mostly in the central and southern portions of Area B. These materials were observed, for the most part, down to a depth of about 2 feet below ground surface. CH2M HILL recommended that no remediation is warranted for the Area B because: 1) historical records indicate that Area B was never used as a disposal area; 2) materials observed in the borings are considered to be surficial as they are commingled with the surface soil; 3).a reevaluation of human health risks for Area B indicated that there are no presumptively unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil and groundwater. Dennis Orenshaw and Curtis DeTore agreed with the recommendation and requested that the information and rationale be included in the Draft FS.
2. CH2M HILL requested a clarification regarding the condition of the consolidation of the excavated material from Site 17 non-time-critical removal action into Site 11. MDE provided clarification that Site 17 material can be consolidated into the Area A landfill only if an impermeable cap be implemented for Area A.

Path Forward:

Based on the discussion points above, the approach of Site 11 Draft FS will be modified to include the following:

- The information regarding the description of fill material at Area B and the rationale to support the no remediation proposal for this Area.
- Incorporation of off site disposal of Site 17 materials into the Soil Cover Alternative (Alternative 2).

Attachment 1

Extent of Solid Waste at Site 11, NDWIH, Indian Head, Maryland

TO: Joe Rail/NAVFAC Washington
Jeff Morris/NAVFAC Washington
David Steckler/NAVFAC Washington
Shawn Jorgensen/NDWIH
Curtis DeTore/MDE
Dennis Orenshaw/EPA

COPIES: Scott Saroff/CH2M HILL
Randy Underwood/CH2M HILL
Margaret Kasim/CH2M HILL

FROM: Gunarti Coghlan/CH2M HILL

DATE: October 3, 2005 (Revised October 12, 2005)

The purpose of this memorandum is to present the findings based on review of soil description of borings in Area B at Site 11 at the Naval District Washington, Indian Head (NDWIH) in Indian Head, Maryland. The review was performed in support of the ongoing FS for Site 11 and considered necessary because of the potential cost saving that can be realized during the implementation of a remedy at the site.

The Final Remedial Investigation (RI) Report (CH2M HILL, 2004) indicated that the extent of waste/fill is limited to Area A. However, review of the description of soil borings in Area B, indicate that wood, bricks, concrete, and pieces of plastic were encountered at some locations, mostly in the central and southern portions of Area B (see attached revised Figure X[1] and attached table). These materials were observed, for the most part, down to a depth of about 2 feet below ground surface.

Although fill material/solid waste was observed at some of the boring locations in Area B, it is recommended that no remedial action be proposed for this area for the following reasons:

1. Based on review of the RI report, the historical uses and contaminant sources for Area A and Area B are different. Landfilling and waste disposal occurred in Area A and incineration or waste burning occurred in Area B. Historical records indicate that Area B was never used as a disposal area.

2. Materials (wood, bricks, concrete, and pieces of plastic) observed in the borings are considered to be surficial as they are commingled with the surface soil.

3. A reevaluation of human health risks for Area B indicated that there are no presumptively unacceptable risks or hazards based on current conditions and exposure pathways to Area B soil (CH2M HILL, 2005). In addition, the reevaluation technical

[1] Question mark on the figure indicates observance of fill in the soil descriptions.

memorandum recommended that remedial actions are not necessarily required for either soil or groundwater at Area B.

References

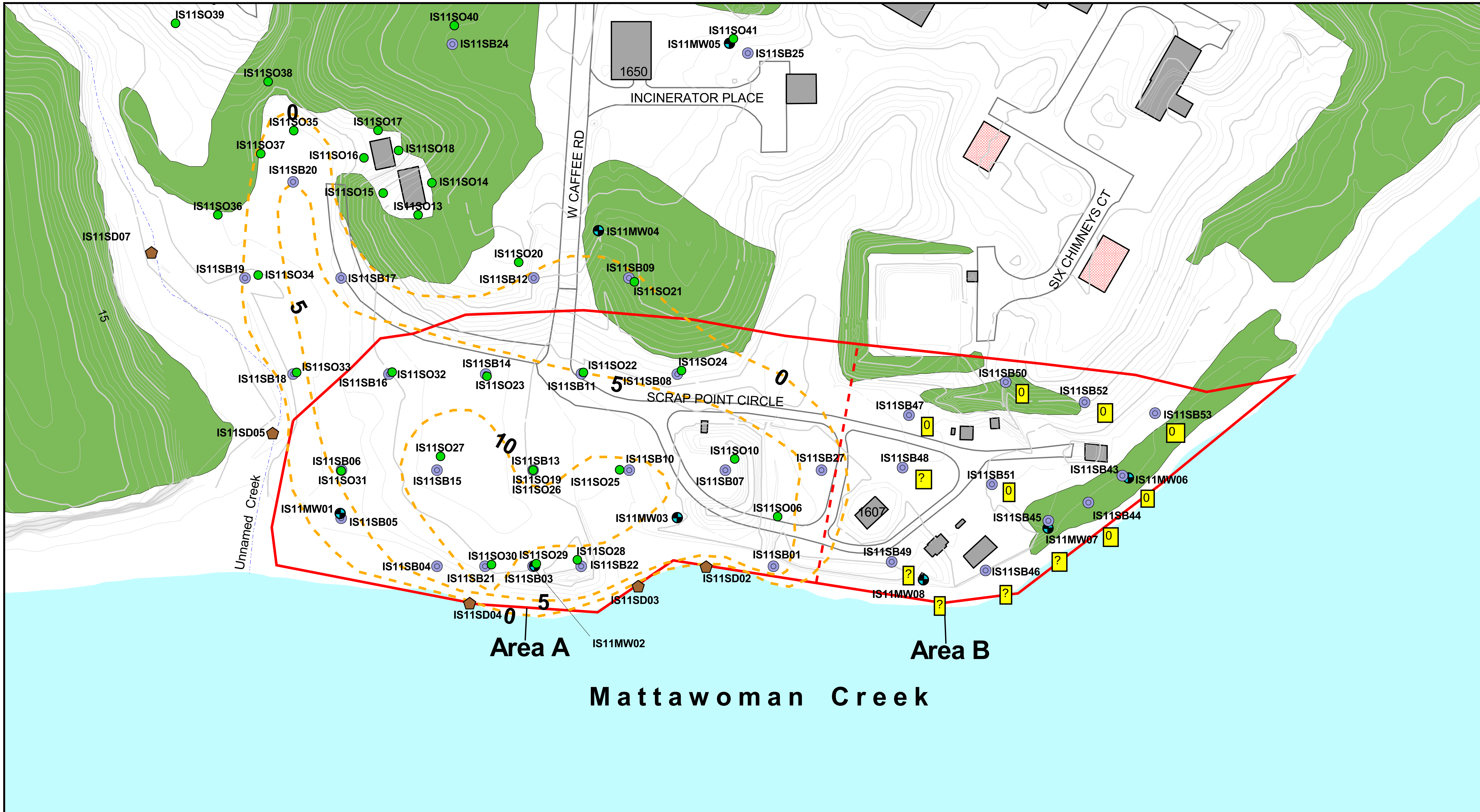
CH2M HILL, 2004. Final Remedial Investigation Report for Sites 11, 13, 17, 21, and 25, Naval District Washington Indian Head, Indian Head, Maryland.

CH2M HILL, 2005. Technical Memorandum - Human Health Risk Evaluation Site 11, NDWIH, Indian Head, Maryland, July 12.

TABLE 1
Summary of Soil Description in Borings - Area B
Site 11, NDWIH, Indian Head, Maryland

Soil Boring/MW	Thickness of fill/waste (feet)		Description of Waste/Fill	Interval fill/waste observed (feet below ground surface)	Comment
	RI Report	FS Report			
IS11SB48	0	1	wood chunks	0-1	
IS11SB45	0	0	no waste		Not enough recovery on 3 spoons; no description
IS11MW07 (Adj to IS11SB45)	not included	3	brick	0-2	Boring soil description indicates waste at the depth interval stated.
			plastic pieces, raw unrotted wood	2-2.6	
IS11SB46	0	2	wood pieces	0-2	
IS11MW08	not included	2	brick	0.9-1.3; 2-2.7	
IS11SB49	0	2	wood, brick, concrete	0-2	

File Path: v:\18gis\indianhead\figures\site11_fs.apr



LEGEND

- Monitoring Well Location
- Surface Soil Location
- Soil Boring Location
- Sediment Sample Location
- Drainage Ditch
- IR Sites
- Buildings
- Demolished Buildings
- Extent of Fill/Waste Thickness
- Railroads
- Roads
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- Wooded Area
- Dense Wooded Area

N

100 0 100 Feet

1" = 100'

Figure X
Locations of RI Sampling Points
Sites 11 Feasibility Study
NDWIH, Indian Head, Maryland

CH2MHILL

Appendix I
Comparative Analysis of Shoreline Stabilization and Nearshore Sediment Remediation Alternatives – Technical Memorandum

TECHNICAL MEMORANDUM CH2MHILL

Comparative Analysis of Shoreline Stabilization and Nearshore Sediment Remediation Alternatives, Site 11, NSF-IH, Indian Head, MD

PREPARED FOR: Indian Head Installation Restoration Team

PREPARED BY: Randy Underwood/CH2M HILL

COPIED: Gunarti Coghlan/CH2M HILL
Margaret Kasim/CH2M HILL
John Burgess/CH2M HILL
K.R. Chang/CH2M HILL

DATE: December 3, 2007

Introduction

CH2M HILL is in the process of finalizing a Feasibility Study (FS) for evaluating remedial alternatives to mitigate soil, solid waste, and nearshore sediment at Site 11, Caffee Road Landfill, a former landfill site along Matawoman Creek at the Naval Support Facility, Indian Head (NSF-IH) in Indian Head, Maryland.

This technical memorandum presents a summary of the alternatives evaluated, process of evaluation, and findings in the comparative analysis of alternatives for shoreline stabilization and remediation of the nearshore sediment. The primary design consideration is how to properly address possible environmental issues associated with the rubble-covered slope along the southern shoreline of the landfill area, which is suspected of being a possible contributor to elevated zinc concentrations in the nearshore sediment. In the FS report, CH2M HILL proposed a remedial alternative, which included removal of building rubble and metal debris down to the low water line, grouting voids within the remaining rubble, and replacing the removed rubble with clean riprap materials. This design would result in removal of the potential future zinc source, encapsulation of contaminants in the remaining rubble, and placement of riprap to provide 100-year flood protection and aesthetic improvement. In addition to source removal, contaminated sediment near the toe of the shoreline would be covered over time with clean sediment as part of the normal sedimentation and attenuation process in the river.

Review of an electronic marked up version of the final FS by representatives of the NSF-IH and the Biological Technical Assistance Group (BTAG), a technical support group to the U.S. Environmental Protection Agency (EPA), indicated that there are uncertainties and disadvantages of the proposed shoreline stabilization measure and the nearshore sediment remedial alternative. Below is a summary of some of the comments:

- The effectiveness of the proposed nearshore sediment remedial alternative is unknown because it relies on unverified natural processes. As a consequence, the timeframe and the costs to achieve the site remediation goals as currently presented in the FS are likely underestimated.

- The shoreline stabilization measure provides minimal benefit to the advancement of the current ecological habitat because it does not provide for a vegetation-based (or "living") shoreline protection which is currently believed to be more environmentally-enhancing than riprap or other "hard" shoreline protection.

These uncertainties and disadvantages were discussed during the Indian Head Installation Restoration Team (IHIRT) meeting on October 3, 2007. As a result of this IHIRT meeting, a visit to Site 11 was conducted on October 17, 2007. Representatives from NAVFAC Washington, NSF-IH, BTAG, the Maryland Department of the Environment (MDE), NOSSA, and CH2M HILL attended the site visit to determine the path forward for addressing the uncertainties of the proposed remedial alternatives. It was agreed at the meeting that CH2M HILL should develop and analyze a number of shoreline alternatives, including "living" shoreline alternatives, to determine if there may be an alternative that will effectively meet technical and environmental requirements of the project. In addition, the IHIRT agreed that in support of the evaluation of these conceptual alternatives and the detailed design of the to-be-selected remedial alternative, CH2M HILL was to conduct a hydrographic survey, which consists of current and bathymetric survey. The survey was conducted on November 26 through 28, 2007.

Description of Alternatives

Seven shoreline stabilization alternatives (Alternatives 1 through 7) were evaluated. They include the current design alternative, Alternative 1A in the FS, as the baseline alternative and six additional alternatives representing various vegetative shoreline alternatives to address technical and environmental issues discussed during the site visit.

Except for Alternative 7, each of the other six alternatives evaluated consists of two options: Option A does not consider a sediment cover (*in situ* cap) whereas Option B considers a sediment cover. These alternatives and options are presented as Alternatives 1A and 1B through Alternatives 6A and 6B in this technical memorandum and the schematic drawing. The reason for the two options is to address elevated zinc concentrations in the nearshore sediment of the Mattawoman Creek. Alternative 7 does not include a separate *in situ* capping option for the nearshore sediment because the soil cover under this alternative would be extended into Mattawoman Creek, thereby, providing an indirect remedy for the nearshore sediment.

The conceptual sediment cover option consists of an erosion-resistant cover layer over the creek sediment within 10 to 15 feet of the toe of the slope. The erosion-resistant cover consists of a geotextile filter layer covered by a minimum of 12 inches of a cobble layer filled and covered with pea gravel. This erosion-resistant cover design follows the cobble beach design at the Fishing Point Landfill site at Naval Air Station Patuxent River in southern Maryland where it is successfully performing as an erosion control layer and breeding ground for river-bottom flora and fauna in the dynamic nearshore environment. The design concepts of the seven alternatives are shown in the schematics drawing. The succeeding paragraphs present a description of the major components of each alternative.

Alternatives 1A and 1B – Partial Rubble Removal, Grout Remaining Rubble, Install Clean Riprap to Top of Slope

Alternative 1A is the design concept in the current FS. For purposes of evaluation, it is the “base alternative”. It was developed to minimize future leaching of potential contaminants from the landfill and to provide 100-year flood protection using riprap designed per common engineering practice. This alternative consists of the following components:

- Remove existing shoreline rubble to the approximate low tide level
- Grout remaining rubble
- Install clean riprap to the top of the slope

Alternative 1B includes all the components in Alternative 1A with the addition of the sediment cover option described above.

Alternatives 2A and 2B – Partial Rubble Removal, Fill and Cover Remaining Rubble, Augment Existing Vegetation with Upland Wetland Plants and Native Grasses

Alternative 2A provides the least disturbance of the existing site condition. Under this alternative, the existing rubble and vegetation along the shoreline will remain in place and be augmented with additional vegetation to create slope protection. This alternative is cost-effective in the benefits it provides: erosion protection benefits of “hard” shoreline protection and environmental/aesthetic benefits of vegetative “living” shoreline protection. This alternative consists of the following components:

- Remove rubble at the top of the slope and metal along the slope
- Fill voids in remaining rubble with soil
- Extend landfill cover to the edge of the slope
- Maintain and protect existing vegetation (e.g., established trees and shrubs)
- Augment existing vegetation on the slope with shrub and tree plantings
- Seed remaining soil fill/cover with native grasses

Alternative 2B includes all the components in Alternative 2A with the addition of the sediment cover option described above.

Alternatives 3A and 3B – Full Rubble Removal, Create 3H:1V Slope, Install Cover, Revetment Mats, and Native Grasses

Alternative 3A is a combination of “hard” and “living” shoreline stabilization methods. This alternative would provide fully covered waste, a “hard” shoreline protection, and environmental/aesthetic benefits of a vegetative “living” shoreline. This alternative consists of the following components:

- Remove all shoreline rubble
- Remove landfill materials to 3H:1V slope configuration
- Install 2-foot soil cover layer on slope
- Install open cell cable-supported concrete revetment mats
- Fill mat void with topsoil.
- Seed with native grasses

Alternative 3B includes all the components in Alternative 3A with the addition of the sediment cover option described above.

Alternatives 4A and 4B – Full Rubble Removal, Create 3H:1V Slope, Install Cover, High Velocity Erosion Control Mat, Upland Wetland Plants, and Native Grasses

Alternative 4A is similar to Alternative 3A, except that the open cell revetment mats are replaced with a high-velocity erosion control matting such as Pyramat, or equivalent. This concept is similar to the design concept used for the Fishing Point Landfill site where a "hard" shoreline protection was not recommended by BTAG. Its benefits are similar to those of Alternative 3A, except that shoreline erosion protection would be reduced due to limitations of the erosion control matting. This alternative consists of the following components:

- Remove all shoreline rubble
- Remove landfill materials to 3H:1V slope configuration
- Install 2-foot soil cover layer on slope
- Install open cell cable-supported concrete revetment mats
- Fill mat void with topsoil
- Seed with native grasses

Alternative 4B includes all the components in Alternative 4A with the addition of the sediment cover option described above.

Alternatives 5A and 5B – Remove Rubble and Waste 50-feet from Existing Slope Toe, Install Marsh Wetland Fringe and Upland Wetland Plants in Remainder of Area

Alternative 5A is a wetland-based "living" shoreline alternative based on removing existing rubble and waste approximately 50 feet back into the landfill, creating a stable soil-covered slope, and installing an upland wetland vegetation with a fringe marsh wetland along the flooded edge. This "living" shoreline alternative would provide source removal, fully cover the waste, partially replace wetland resources destroyed during initial landfilling activities, and provide storm protection limited by the capability of the wetland to dissipate wave action and prevent erosion.

Alternative 5A consists of the following components:

- Remove all shoreline rubble
- Remove waste to create an approximate 4% bottom slope 50 feet into the landfill and a 3H:1V back slope
- Install 2 feet of soil cover
- Install marsh wetland fringe in area below the tide line
- Install upland wetland plant in the remaining wetland area
- Seed remaining area with native grasses

Alternative 5B includes all the components in Alternative 5A with the addition of the sediment cover option described above.

Alternatives 6A and 6B – Remove Rubble and Waste 50-feet from Existing Slope Toe, Install 50-foot-wide Marsh Wetland with Upland Wetland Plants in the Back Slope

Alternative 6A is similar to Alternative 5A, except that the waste excavation in the 50-foot fringe would be made deeper and flatter to provide for a 50-foot-wide marsh wetland with upland wetland plantings on the back slope. This wetland configuration would likely resemble more closely the original wetland (Alternative 5 in the FS report) in the area, but would likely have similar benefits and disadvantages as the wetland configuration in Alternative 5A due to its limited width.

Alternative 6A consists of the following components:

- Remove all shoreline rubble
- Remove waste to create a flat indented surface 50 feet into the landfill and a 3H:1V back slope
- Install 2 feet of sandy silt soil on the bottom of the excavation
- Install 2 feet of soil cover on the back slope
- Install a 50-foot-wide marsh wetland fringe in the bottom of the wetland area
- Install upland wetland plant on the back slope
- Seed remaining area with native grasses

Alternative 6B includes all the components in Alternative 6A with the addition of the sediment cover option described above.

Alternative 7 – Partial Rubble Removal, Cover Remaining Rubble to Create a 3H:1V Slope into Mattawoman Creek, Install High Velocity Erosion Control Mat, and Vegetate the Slope with Wetland Plants and Native Grasses

Alternative 7 considers extending the landfill soil cover over the existing rubble and nearshore sediment and creating a living shoreline on the slope. Under this alternative, rubble and waste removal will be minimal and primarily conducted to create proper grading for installing the soil cover. Although this alternative effectively provides soil cover over the landfill and the benefit of living shorelines, as well as addresses excavation safety, construction of the cover system into Mattawoman Creek may create some additional construction, permitting, and wetland mitigation requirements. This alternative consists of the following components:

- Remove rubble on top of the slope
- Create a rock and gravel foundation fill to the high tide level in the Mattawoman Creek
- Install an earth fill to extend the soil cover over the remaining rubble and foundation fill
- Install permanent erosion control mat similar to Alternative 4
- Install upland wetland plants on the slope
- Seed remaining soil fill/cover with native grasses

Because the rock fill and soil fill extend over the nearshore sediments, Alternative 7 is not evaluated separately for a sediment cover option.

Preliminary Evaluation of Alternatives

Criteria and Preliminary Scoring

The applicability of each alternative to the sites considered factors such as: effectiveness of the alternative to achieve the remedial action objectives, remediation worker safety because of the potential presence of munitions and explosives of concern, ecological habitat advancement, and cost. The 13 alternatives are not evaluated against the traditional nine criteria based on the NCP requirements. Instead, they are evaluated against 13 criteria that represent various regulatory, technical, safety, cost, and environmental concerns specific to Site 11. The 13 criteria have been divided into "Major" and "Minor" groups, as listed below.

Major Criteria:

Major criteria are those criteria deemed to be most critical to addressing primary regulatory, performance, safety, and implementation issues. They include the following:

- Compliance with the Applicable, Relevant, and Appropriate Requirements (ARARs)
- Long-Term Erosion and Storm Protection
- Degree of Degradation of Habitat/Space Diversification
- Remediation Worker Safety Risk due to Presence of Munitions and Explosives of Concern (MECs)
- Ability to Address Nearshore Sediment Contamination
- Constructability
- Construction Cost
- Specific Requirements including submittal and approval of explosives safety submission and meeting the substantive requirements for construction in the creek.

Minor Criteria:

Minor criteria are criteria that are important to long-term project satisfaction, but are not deemed to be as critical as the major criteria listed above. They include the following:

- Aesthetic
- Maintenance
- Design Life
- Proven Effectiveness
- Consistency with Chesapeake Bay Program management practices

Table 1 summarizes the thirteen alternatives, evaluation criteria, and weighting factors for each criterion. Each of the thirteen alternatives was evaluated against the thirteen criteria. A scoring system was developed for each criterion to allow the comparison of the alternatives against each other so as to determine which alternative provides the best combination of benefits (that is, highest overall score) relative to competing project requirements. Weighting factors of 1.5 were applied to the Major Criteria and 1.0 to the Minor Criteria because the major criteria represent critical and site-specific requirements to be met at Site 11.

The scoring of each criterion was based on a scale of 0 to 5, with 0 being non-compliant and 5 being fully compliant with the criterion. The sole exception to this convention is the cost criterion where scores of 0 to 5 represent various cost ranges shown in the footnotes of Table 1. The basis of comparative costs used for this scoring are discussed below. The total score for each alternative in Table 1 was based on the sum of the weighted individual scores for each criterion (that is, sum of all 13 evaluation criteria) for that alternative. The overall ranking for each alternative is based on the total score, with the highest total score representing the most favorable alternative and the lowest score representing the least favorable alternative.

Comparative Costs

Comparative costs for the various alternatives are presented in Table 1. For rough order of magnitude (ROM) costs comparison purpose, the accuracy of the costs is within the plus 50 percent to minus 30 percent range. These costs are not intended for design or financial planning. They are costs of major work items that were estimated based on unit costs from similar work and the following assumptions:

- Rubble removal costs will be 1.5 normal costs for this item due to the potential presence of MEC.
- Landfilled waste removal costs will be 3.0 times the normal removal cost due to the potential presence of MEC.
- Excavated rubble and waste will be non-hazardous and will be disposed of at a local Subtitle D landfill facility.
- Markups include 20 percent for design contingencies, 10 percent for general conditions, and 15 percent for contractor overhead and profit.

The actual costs associated with waste removal and disposal could be significantly higher if substantial quantities of MECs are present and/or if portions of the waste are found to be hazardous waste requiring hazardous waste disposal. Furthermore, the ROM costs do not account for the cost associated with the demilitarization and treatment of any MEC cleared during the excavation of waste.

Preliminary Evaluation and Ranking

Table 2 presents the overall ranks, total scores, and ROM costs for the evaluated alternatives; the information presented in this table is taken from Table 1.

TABLE 2
Summary of Overall Ranking, Total Evaluation Scores, and ROM Costs of Alternatives
Site 11 Feasibility Study Support
NSF-IH, Indian Head, Maryland

Overall Rank	Alternative		Total Score	ROM Cost
1	2B	Similar to Alternative 2A with Gravel Blanket into Creek	68.5	$0.21
2	2A	Partially Remove Rubble, Fill with Soil, Enhance Existing Vegetation with Plantings	67	$0.13
3	7	Extend Landfill Cover over Rubble and Into Creek	65.5	$0.44
4	4B	Similar to Alternative 4A with Gravel Blanket into Creek	63.5	$0.95
5	1B	Similar to Alternative 1A with Gravel Blanket into Creek	63	$0.75
5	3A	Remove Rubble, Create 3H:1V Slope, Install Soil Cover and Revetment Mats, Vegetate	63	$1.03
6	3B	Similar to Alternative 3A with Gravel Blanket into Creek	62.5	$1.09
7	4A	Remove Riprap, Create 3H:1V Slope, Install Soil Cover, High Velocity ECM, and Upland Plants	62	$0.90
8 (Baseline)	1A	Remove Rubble to Water Line, Grout Remaining, Install Riprap on Slope (Current Design Alternative)	58.5	$0.66
9	5A	Remove Rubble/Waste Back 50 feet, Install Cover, Fringe Marsh, and Upland Wetlands Marsh Wetland Fringe	51	$1.90

Overall Rank	Alternative		Total Score	ROM Cost
9	5B	Similar to Alternative 5A with Gravel Blanket into Creek	51	$1.96
10	6A	Remove Rubble/Waste Back 50 feet, Install Cover, Marsh Wetland in Bottom and Upland Wetland on Slopes	48	$2.51
10	6B	Similar to Alternative 6A with Gravel Blanket into Creek	48	$2.57

Seven of the thirteen alternatives rank higher than the current design (baseline) alternative (Alternative 1A). Alternatives 2B and 2A represent the highest ranking, least cost (substantially lower than the current baseline alternative and other alternatives), and the least intrusive alternatives. However, these alternatives present two major drawbacks: (1) verification that the remaining soil-filled and vegetated rubble will not be a leaching concern in the future and (2) the adequacy of the vegetated slope as a "living" shoreline.

Alternative 7 is the third highest-ranked alternative. It provides an alternative within the $500K range that also addresses the nearshore sediment, waste excavation and safety, and living shoreline issues. Alternative 7 may entail a significant cost and time saving because ESS submittal and approval may not be necessary due to the minimized or zero waste excavation associated with this alternative. The primary disadvantage for this alternative is related to meeting additional substantive requirements that may become necessary to extend the toe of the landfill cover into Matawoman Creek. This alternative may also result in additional study, design, and construction costs if mitigation is required due to the modification of the existing waterway.

Alternative 4B, which represents shoreline protection similar to the "living" shoreline protection accepted by BTAG at the Fishing Point Landfill, is the next highest-ranked alternative. This alternative, which does not provide quite the high level of flood protection as the "hard" shoreline stabilization alternatives, probably provides reasonable protection as evidenced by performance of the Fishing Point Landfill shoreline during hurricane conditions in September 2003. The primary concern is additional cost, given that these alternatives are about $250 to $300K higher than the base alternative and over $750K higher than the least cost alternative due to the necessity of removing existing rubble and waste for this alternative. The cost difference could be substantially higher if MECs and/or hazardous waste are found to be present.

Alternatives 1B and 3A were ranked fifth. Alternative 1B, which ranks fifth, is a modification of the baseline alternative (Alternative 1A). This alternative, however, does not have a "living" shoreline component. Alternative 3A, which also represent hybrid "hardened" and "living" shoreline protection, would be more protective than Alternative 4B, but at an increased cost. Alternative 3A is also susceptible to significant cost increases if MEC or hazardous waste is present. Furthermore, it does not provide the full benefit of a "living" shoreline. Alternative 3B was ranked sixth, below Alternative 3A because of the added design complexity associated with the installation of the *in situ* capping component for the nearshore sediment. Similar to Alternative 3A, Alternative 3B does not provide the full benefit of a "living shoreline. Alternative 4A was ranked seventh because it does not incorporate the in situ capping for the nearshore sediment contamination and the moderate risk for remediation safety worker during the removal of rubble and waste.

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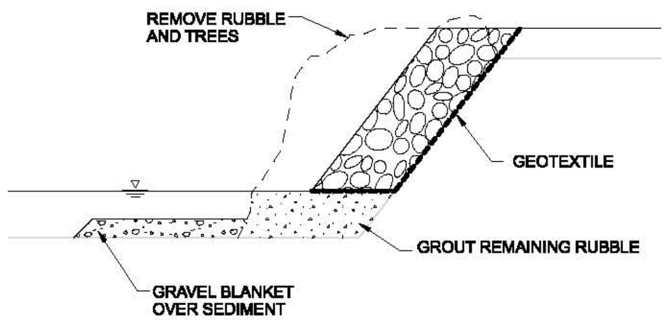
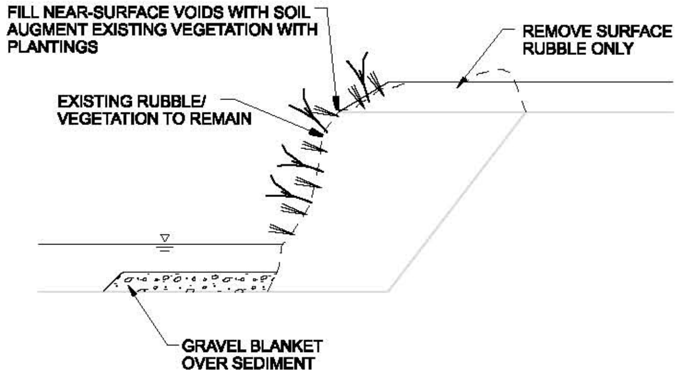


1. REMOVE RUBBLE TO LOW WATER LINE
2. GROUT REMAINING RUBBLE
3. INSTALL RIPRAP SLOPE
4. INSTALL COVER TO RIPRAP

1A - WITHOUT GRAVEL BLANKET

1B - WITH GRAVEL BLANKET

ALTERNATIVES 1A AND 1B - SCHEMATIC



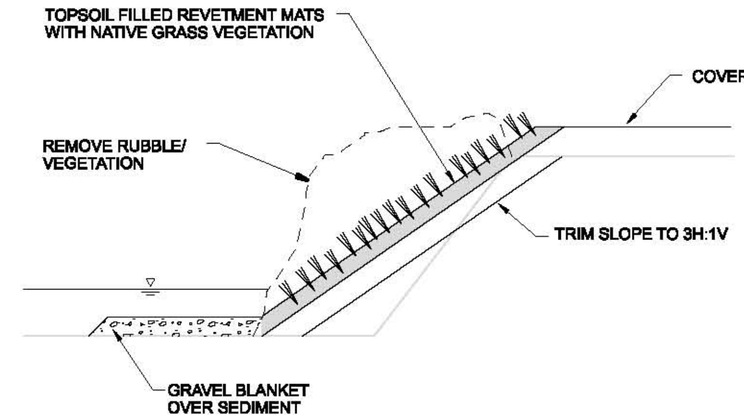
1. REMOVE METAL AND TOP OF RUBBLE TO EXISTING LANDFILL SURFACE.
2. LEAVE REMAINING RUBBLE/VEGETATION IN PLACE.
3. EXTEND CAP OVER TOP OF RUBBLE.

4. FILL VOIDS WITH SOIL. INSTALL UPLAND WETLAND PLANTS.

2A- WITHOUT GRAVEL BLANKET

2B - WITH GRAVEL BLANKET

ALTERNATIVES 2A AND 2B - SCHEMATIC

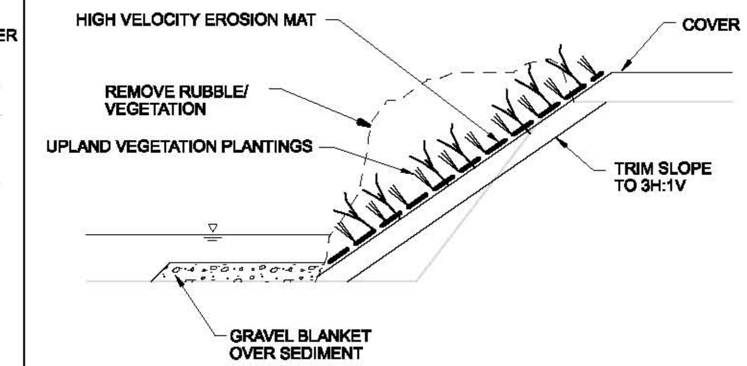


1. REMOVE RUBBLE
2. REMOVE WASTE TO 3H:1V SLOPE
3. PROVIDE 2' MIN COVER
4. INSTALL REVETMENT MATS
5. FILL REVETMENT MATS W/TOPSOIL, SEED WITH NATIVE GRASSES.

3A- WITHOUT GRAVEL BLANKET

3B - WITH GRAVEL BLANKET

ALTERNATIVES 3A AND 3B - SCHEMATIC



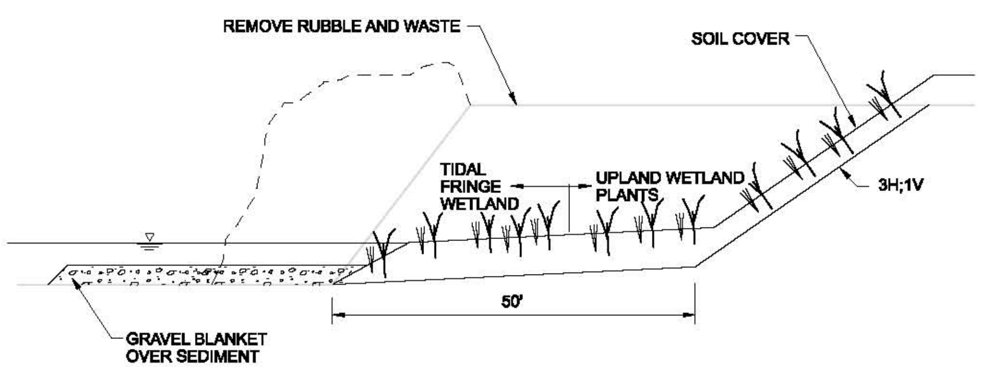
1. REMOVE RUBBLE
2. REMOVE WASTE TO 3H:1V SLOPE
3. PROVIDE 2' MIN COVER
4. INSTALL HIGH VELOCITY EROSION MAT
5. INSTALL UPLAND WETLAND PLANTINGS
6. FILL EROSION MAT W/TOPSOIL, SEED BETWEEN PLANTINGS WITH NATIVE GRASSES

4A- WITHOUT GRAVEL BLANKET

4B - WITH GRAVEL BLANKET

ALTERNATIVES 4A AND 4B - SCHEMATIC

NOTES: 1. WITH THIS CONFIGURATION, SOME WASTE MAY REMAIN BELOW WETLAND AREAS.



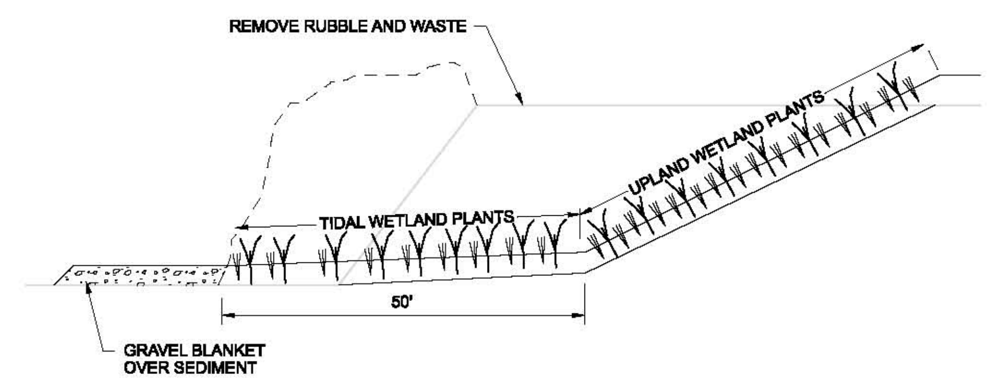
5A- WITHOUT GRAVEL BLANKET

5B - WITH GRAVEL BLANKET

1. REMOVE RUBBLE AND WASTE TO CREATE 3H:1V SLOPE 50' BACK FROM CURRENT TOE AND REQ'D BASE SCOPE
2. INSTALL 2' MIN COVER WITH APPROPRIATE EROSION MAT ON 3:1 SLOPE.
3. PLANT TIDAL FRINGE WETLAND
4. PLANT UPLAND WETLAND PLANTS
5. SEED BETWEEN UPLAND PLANTS WITH NATIVE GRASSES

ALTERNATIVES 5A AND 5B - SCHEMATIC

NOTES: 1. WITH THIS CONFIGURATION, SOME WASTE MAY REMAIN BELOW WETLAND AREAS.

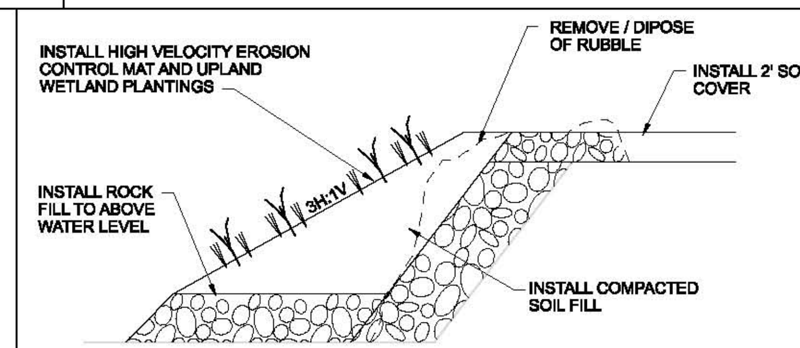


6A- WITHOUT GRAVEL BLANKET

6B - WITH GRAVEL BLANKET

1. REMOVE RUBBLE AND WASTE TO CREATE CONFIGURATION
2. INSTALL 2' MIN APPROPRIATE COVER
3. PLANT WETLAND PLANTS IN BOTTOM
4. PLANT UPLAND PLANTS
5. SEED REMAINING SLOPE AREA WITH NATIVE GRADDES

ALTERNATIVES 6A AND 6B - SCHEMATIC



1. REMOVE METAL AND TOP OF RUBBLE TO EXISTING LANDFILL SURFACE.
2. INSTALL GEOTEXTILE AND ROCKFILL IN CREEK TO HIGH TIDE LEVEL.
3. INSTALL SOIL COVER 3H:1V SLOPE.
4. INSTALL HIGH VELOCITY EROSION CONTROL MAT.
5. PLANT UOLAND WETLAND PLANTS ON SLOPE.
6. SEED BETWEEN UPLAND PLANTS WITH NATIVE GRASSES.

ALTERNATIVE 7 - SCHEMATIC

NOTE: SCHEMATICS ONLY, DETAILS WILL BE DEVELOPED IF ALTERNATIVE IS SELECTED.
NOT TO SCALE

DESIGN CONCEPTS OF LIVING SHORELINE STABLIZATION ALTERNATIVES
SITE 11 FEASIBILITY STUDY SUPPORT
NSF-IH, INDIAN HEAD, MARYLAND

CH2MHILL

TABLE 1
Comparative Analysis of Various Living Shoreline Stabilization and Nearshore Sediment Remediation Alternatives
Site 11 Feasibility Study Support
NSF-IH, Indian Head, Maryland

		Major Criteria								Minor Criteria							
Alternative	Description	Compliance with ARARs	Long-Term Erosion and Storm Protection	Degree of Degradation of Habitat/Species Diversification	Remediation Worker Safety Due to MECs	Ability to Address Nearshore Sediment Contamination	Constructability	Cost	Special Requirements (ESS and Other Substantive Requirements)	Aesthetics	Maintenance	Design Life	Proven Effectiveness	Consistent with Chesapeake Bay Program Management Practices	**TOTAL SCORE**	ROM Cost	Overall Ranking
	Proposed Weighting Factors	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1	1	1	1		$ Millions	
1A	Remove Rubble to Water Line, Grout Remaining, Install Riprap on Slope (Current Design Alternative)	5	5	1	3	3	4	3	3	2	5	5	5	1	58.5	$ 0.66	8
1B	Similar to Alternative 1A with Gravel Blanket into Creek	5	5	2	3	5	4	3	3	2	4	4	5	3	63	$ 0.75	5
2A	Partially Remove Rubble, Fill with Soil, Enhance Existing Vegetation with Plantings	3	5	3	4	3	5	5	4	3	4	4	5	3	67	$ 0.13	2
2B	Similar to Alternative 2A with Gravel Blanket into Creek	3	5	4	4	5	4	5	3	3	4	4	5	3	68.5	$ 0.21	1
3A	Remove Rubble, Create 3H:1V Slope, Install Soil Cover and Revetment Mats, Vegetate	5	5	3	2	4	4	1	4	3	5	5	5	3	63	$ 1.03	5
3B	Similar to Alternative 3A with Gravel Blanket into Creek	5	5	4	2	5	4	1	3	3	4	4	5	3	62.5	$ 1.09	6
4A	Remove Riprap, Create 3H:1V Slope, Install Soil Cover, High Vel ECM, and Upland Plants	5	4	4	2	4	4	2	3	5	3	3	4	5	62	$ 0.90	7
4B	Similar to Alternative 4A with Gravel Blanket into Creek	5	4	5	2	5	4	2	2	5	3	3	4	5	63.5	$ 0.95	4
5A	Remove Rubble/Waste Back 50 feet, Install Install Cover, Fringe Marsh, and Upland Wetlands Marsh Wetland Fringe	4	3	5	1	4	3	0	2	5	2	3	3	5	51	$ 1.90	9
5B	Similar to Alternative 5A with Gravel Blanket into Creek	4	3	5	1	5	3	0	1	5	2	3	3	5	51	$ 1.96	9
6A	Remove Rubble/Waste Back 50 feet, Install Cover, Marsh Wetland in Bottom and Upland Wetland on Slopes	4	3	5	0	4	2	0	2	5	2	3	3	5	48	$ 2.51	10
6B	Similar to Alternative 6A with Gravel Blanket into Creek	4	3	5	0	5	2	0	1	5	2	3	3	5	48	$ 2.57	10
7	Extend Landfill Cover over Rubble and Into Creek	5	4	4	4	5	2	4	3	5	3	3	4	4	65.5	$ 0.44	3

Notes:
1. Ranking Criteria (Except for Cost) 5= Full Compliance 0=Non-Compliance
2. Cost Ranking: 5= Less than $250K, 4= $250K to $500K, 3- $500K to $750K, 2=$750K to $1.0 M, 1=$1M to $1.25M, 0=Greater than $1.25M
3. All Costs Assume Non-Hazardous Waste and Disposal at Nearby Permitted Non-Haz Waste Landfill
4. Rubble Removal Costs Assume Multiplier of 2 for Special Safety Requirements
5. Waste Removal Costs Assume Multiplier of 3 for Special Safety Requirements

Appendix J
Detailed Cost Estimate

Appendix I
Remedial Alternatives Cost Summary*
Site 11 Feasibility Study
NSF-IH, Indian Head, Maryland

	Remedial Alternatives	Construction Time (weeks)	Operation Time (years)	2007/2008 Capital Cost**	2007/2008 Lifetime O&M**	Lifetime Present Worth O&M	Total Present Worth
Solid Waste, Soil, and Groundwater in Area A							
2	Soil Cover, Groundwater LTM, and ICs	25	30	$ 2,524,300	$ 874,400	$ 488,500	**$ 3,012,800**
3	RCRA C Cap, Groundwater LTM, and ICs	29	30	$ 3,191,400	$ 970,400	$ 532,900	**$ 3,724,300**
4	Excavation and Off-Site Disposal	12	NA	$ 9,256,400	$ 72,400	$ 63,200	**$ 9,319,500**
Near Shore Sediments							
2	Long-Term Monitoring and ICs	0	30 years	$ 17,400	$ 120,800	$ 71,300	**$ 88,600**
3	In Situ Capping and ICs	1	30 years	$ 78,800	$ 54,000	$ 21,900	**$ 100,600**

Notes:
* Does not include cost for MPPEH management, transporation, storage, handling, or treatment if needed.
** Adjusted from 2004 cost using 4% escalation factor
All costs are roundup by 2 significant digits

REMEDIAL ALTERNATIVE 2	LOCATION:	MEDIA:	Construction time:	25 weeks
Soil Cover, Living Shoreline Installation, ICs, and Groundwater Monitoring	Site 11, Caffee Road Landfill NSF-IH, Indian Head, Maryland	Solid Waste and Contaminated Soil	Operation time:	30 years
			Post Remediation Monitoring:	Included in the groundwater monitoring component

Cost Component	Qty	Unit	Cost Source/Assumptions	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost

DESCRIPTION OF ALTERNATIVE:

Installation of soil cover to prevent contact with waste and contaminated soil. The cover shall have a minimum 24-inch thickness of soil. Stabilization of the Mattawoman Creek shoreline using a gravel fill base, soil cover, erosion control matting, and wetland plants and native grasses. Implementation of operation and maintenance and ICs for 30 years, including biannual field inspection and mowing, five-yearly cover repair, and five-year reviews.

ASSUMPTIONS:

	Square Feet (SF)		acres	
1) Area of Attainment	121,078		2.78	
2) Area of Excavation	0		0	
	Cubic feet (CF)		**Cubic yards (CY)**	**tons (0.058 tons/CF)**
3) Excavation and disposal costs for removal of soil at Site 17 included since the selection of an alternative for Site 11 directly impacts Site 17.	12960	or	480	752
4) Total cut and fill volume to crate the base grade fro the landfill cover is (from Figure 4-1 FS):	63	**CY**	99	**tons**
5) The soil cover area is approx.	121,078	**SF**	2.78	**acres**
6) Required soil fill material to install the 2' soil cover and to create the base grade for the cover is approx.			8969	**CY**
7) Total fill material in place:			9032	**CY**

8) No wetland mitigation.

9) Swelling factor: 10%

10) Perimeter of the soil cover area is approx. 1,320.00 **Feet (ft)**

11) Surface water management would be accomplished through rip rap ditches along the perimeter of the cover.

12) Asphalt paved area requiring demolition 780 **SF**

13) Length of shoreline for stabilization: 900 LF; Width: 15 ft; Low tide water line: 6 ft

14) Volume of shoreline debris to be removed and rip-rap to be installed (to low tide water line) assuming % void of : 50% 40500 CF 2349 tons

15) Sampling includes three years of quarterly sampling, and annual sampling in years 4 & 5.

16) Wells to be abandoned: 3 Wells to be installed: 3 Wells to be sampled: 7

17) Sources of costs are 2004 RS Means Site Work & Landscape Cost Data, RS Means Environmental Remediation Cost Data - Unit Price, vendo quotes, and professional judgment based on similar projects.

18) Inflation factor to adjust 2004 cost to 2007 cost: 4% (applied to the total capital cost)

Cost Component	Qty	Unit	Cost Source/Assumptions	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Institutional Controls/Planning												**$5,000.00**
Site-Specific LUC	1	lump sum	Allowance		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Permitting, Planning, and Reporting												**$12,500.00**
Health and Safety Plan	1	lump sum	CCI, 2008		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
FSP, QAPP, and DQOs	1	lump sum	CCI, 2008		$7,500.00	$7,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,500.00
Site Preparation				**10**								**$18,306.91**
Site clearing (dozer light)	2.78	acre	M 31 11 10 10 0020, CCI modified	5	$2,500.00	$6,950.00	$1,297.95	$3,608.30	$0.00	$0.00	$0.00	$10,558.30
Site demolition (road demolition - assume asphalt paved)	780	SY	M 02 41 13 17 5010	2	$2.29	$1,786.20	$1.57	$1,224.60	$0.00	$0.00	$0.00	$3,010.80
Survey	3	days	M02 21 13 13 0200	3	$1,509.24	$4,527.72	$70.03	$210.09	$0.00	$0.00	$0.00	$4,737.81
Site 17 Excavation and transport of soil to offsite landfill				**7**								**$77,895.45**
Landfill Fees	752	ton	E 33 19 7269		$0.00	$0.00	$0.00	$0.00	$90.33	$67,899.25	$0.00	$67,899.25
Dump Truck Transportation Minimum Charge	672	miles	E 33 19 0210, adjusted by 200%		$0.00	$0.00	$0.00	$0.00	$5.70	$3,830.40	$0.00	$3,830.40
Loading soil into truck	480	CY	E 33 19 0150	7	$0.74	$355.20	$1.41	$676.80	$0.00	$0.00	$0.00	$1,032.00
Excavation (1 CY backhoe w/ FE Loader)	70	hrs	E 17 03 0431	1	$40.37	$2,825.90	$32.97	$2,307.90	$0.00	$0.00	$0.00	$5,133.80
Soil Cover Construction				**45**								**$249,475.16**
Borrow, loading, and spreading - top soil, shovel, 1CY bucket (6" thick)	2,468	CY	M 31 23 23 15 7000	3	$0.78	$1,924.80	$1.32	$3,257.35	$20.00	$49,353.74	$0.00	$54,535.89
Borrow, loading, and spreading - common earth, shovel, 1CY bucket (18" thick)	10,886	CY	CCI, 2008	19	$0.78	$8,491.16	$1.65	$17,962.07	$13.00	$141,519.32	$0.00	$167,972.55
Grading - large area	13,453	SF	M 31 22 16 10 0100	7	$0.18	$2,421.56	$0.19	$2,556.09	$0.00	$0.00	$0.00	$4,977.65
Compaction - sheepsfoot, 12" lifts, 4 passes	9,032	CY	M 31 23 23 23 5720	7	$0.19	$1,716.08	$0.49	$4,425.68	$0.00	$0.00	$0.00	$6,141.76
Trenching for dikes and ditches- 1-4' deep, 3/8 CY backhoe	1,320	CY	M 31 23 16 13 0050	9	$4.23	$5,583.60	$2.15	$2,838.00	$0.00	$0.00	$0.00	$8,421.60
Hydroseeding	121	M.SF	M 02920 320 2400	2	$11.65	$1,410.56	$6.82	$825.75	$42.86	$5,189.40	$0.00	$7,425.71
Shoreline Stabilization				**60**								**$480,695.00**
Site Preparation												
Light Clearing	0.15	acre	$3,000 /AC	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$450.00	$450.00
Install Temp ECM	2,230	SY		CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$4.00	$8,920.00	$0.00	$8,920.00
Silt curtain (Inst/Rem)	5,200	SF	$3.15/SF	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$16,380.00	$16,380.00
Shoreline Stabilization												
Surface debris removal	450	CY	$20.00/ CY - 2.0 UC Mult for Safety	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18,000.00	$18,000.00
Transportation/Disposal of Removed Surface Rubble	810	TN	$60.00/ Ton - Assume 1.8 T/CY	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$48,600.00	$48,600.00
Install Geotextile	3,800	SY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9,500.00	$9,500.00
Install Rock Fill	3500	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$157,500.00	$157,500.00
Crane/Clamshell	60	days		CH2M HILL CCI	$0.00	$0.00	$1,700.00	$102,000.00	$0.00	$0.00	$0.00	$102,000.00
General Fill	2400	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$15.00	$36,000.00	$0.00	$36,000.00
Install Topsoil	325	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$25.00	$8,125.00	$0.00	$8,125.00
High Velocity ECM	2230	SY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$25.00	$55,750.00	$0.00	$55,750.00
Install Vegetation				CH2M HILL CCI								
Install Upland Wetland Shrubs (6' c-c)	486	EACH	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$20.00	$9,720.00	$0.00	$9,720.00
Install Upland Trees (10' c-c)	175	EACH	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$50.00	$8,750.00	$0.00	$8,750.00
Seeding	0.5	acre			$0.00	$0.00	$0.00	$0.00	$2,000.00	$1,000.00	$0.00	$1,000.00

REMEDIAL ALTERNATIVE 2	LOCATION:	MEDIA:	Construction time: 25 weeks
Soil Cover, Living Shoreline Installation, ICs, and Groundwater Monitoring	Site 11, Caffee Road Landfill	Solid Waste and Contaminated Soil	Operation time: 30 years
	NSF-IH, Indian Head, Maryland		Post Remediation Monitoring: Included in the groundwater monitoring component

Cost Component	Qty	Unit	Cost Source/Assumptions	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
MEC Avoidance (minimal intrussive activities are anticipated)												**$39,022.00**
Mob/Demob	2	person	CH2M HILL Rates		$750.00	$1,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,500.00
OE Avoidance Team	20	days	CH2M HILL Rates		$1,170.10	$23,402.00	$0.00	$0.00	$0.00	$0.00	$0.00	$23,402.00
OE Avoidance Equipment	20	days	CH2M HILL Rates		$0.00	$0.00	$85.00	$1,700.00	$0.00	$0.00	$0.00	$1,700.00
OE Avoidance Report												
OE Avoidance Plan (Draft and Final)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
Health and Safety Plan (including briefing)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
After Action Report	1	each	CH2M HILL Rates		$1,600.00	$1,600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,600.00
Lodging and Per diem	60	day			$0.00	$0.00	$0.00	$0.00	$147.00	$8,820.00	$0.00	$8,820.00
Abandoment and Installation of Monitoring Wells				**2**								**$2,354.88**
Well abandonment	24	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$22.33	$535.92	$0.00	$535.92
8" Diameter soil boring for well advancement	24	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$22.33	$535.92	$0.00	$535.92
2" diameter, 5' PVC well screen	3	Unit	BOA Rates		$0.00	$0.00	$0.00	$0.00	$37.67	$113.00	$0.00	$113.00
Installation of flush-mounted covers	3	Unit	BOA Rates		$0.00	$0.00	$0.00	$0.00	$258.33	$775.00	$0.00	$775.00
Well Development	3	hrs	BOA Rates						$96.67	$290.01	$0.00	$290.01
Well Installation 2" PVC riser, minimum of 6' per each of the 3 wells to be replaced	9	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$11.67	$105.03	$0.00	$105.03
Construction Oversight												**$199,312.64**
Engineer (P2)	25	weeks	Professional Judgement		$2,450.00	$60,760.00	$0.00	$0.00	$0.00	$0.00	$0.00	$60,760.00
Site Health and Safety (P2)	25	weeks	Professional Judgement		$2,450.00	$60,760.00	$0.00	$0.00	$0.00	$0.00	$0.00	$60,760.00
Superintendent (P3)	25	weeks	Professional Judgement		$3,136.80	$77,792.64	$0.00	$0.00	$0.00	$0.00	$0.00	$77,792.64
Preconstruction Submittals												**$160,059.31**
Preconstruction survey, design basis, pre-draft, draft, and final design, specifications, H&S plans, and MEC avoicance plan	1	lump sum	15% of total construction cost		$160,059.31	$160,059.31	$0.00	$0.00	$0.00	$0.00	$0.00	$160,059.31
General Conditions												**$106,706.20**
Decontamination, temp. facilities, sed. & erosion control, temp. fence, etc.	1	lump sum	10% of total construction cost		$106,706.20	$106,706.20	$0.00	$0.00	$0.00	$0.00	$0.00	$106,706.20
Contractor Overhead and Profit												**$160,059.31**
Home office cost, etc.	1	lump sum	15% of total construction cost		$160,059.31	$160,059.31	$0.00	$0.00	$0.00	$0.00	$0.00	$160,059.31
Mob/Demob (include perdiem +lodging)												**$106,706.20**
Mob & demob of equip & personnel	1	lump sum	10% of total construction cost		$106,706.20	$106,706.20	$0.00	$0.00	$0.00	$0.00	$0.00	$106,706.20
2004 SUBTOTAL CAPITAL COST						**$816,838.44**		**$143,592.63**		**$407,232.00**	**$250,430.00**	**$1,618,093.07**
2007 SUBTOTAL CAPITAL COST (ADJUSTED WITH INFLATION FACTOR)						**$849,511.98**		**$149,336.33**		**$423,521.28**	**$260,447.20**	**$1,682,816.79**
Scope Contingency	30%											**$504,845.04**
Bid Contingency	20%											**$336,563.36**
TOTAL CAPITAL COST												**$2,524,225.19**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Cover Maintenance												**$3,306.09**
Biannual mowing - tractor with rotary mower	121	M.SF	M 02935 300 1660		$12.25	$1,483.21	$10.10	$1,222.89	$0.00	$0.00	$0.00	$2,706.09
Biannual inspection	8	hrs	E 99 11 0403		$75.00	$600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.00
Cover Repair - every five years												**$50,484.50**
Assume 2% of total capital cost	1	lump sum	Professional Judgment		$50,484.50	$50,484.50	$0.00		$0.00	$0.00	$0.00	$50,484.50
Groundwater Sampling and Analysis												**$10,881.14**
Sample Collection												**$2,629.66**
Sample collection - 2 crew, 10 hrs/day, $50/hr	2	days	Professional Judgment		$1,000.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,000.00
Disposable and decon materials per sample	7	samples	E 33 02 0401, 33 02 0402, 33 02 0561		$0.00	$0.00	$0.00	$0.00	$24.90	$174.30	$0.00	$174.30
Equipment Rental	2	days	E 33 02 0573, 33 02 0578		$0.00	$0.00	$227.68	$455.36	$0.00	$0.00	$0.00	$455.36
Lab Analysis (30% QA/QC)												**$3,251.48**
Metals (total and dissolved)	19	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,601.48	$2,601.48
Chloride, nitrite/nitrate, sulfate	10	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$650.00	$650.00
Report	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00		$0.00	$0.00	$0.00	**$5,000.00**
Five-Year Review												**$10,000.00**
Report - Engineer	1	lump sum	Professional Judgment		$10,000.00	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10,000.00
Site Closure												**$15,000.00**
Report development	1	lump sum	Allowance		$15,000.00	$15,000.00	$0.00		$0.00	$0.00	$0.00	$15,000.00

PRESENT WORTH CALCULATION

REMEDIAL ALTERNATIVE 2 - SOIL COVER, GROUNDWATER MONITORING, AND ICs

Location:	Site 11, Caffee Road Landfill, NSF-IH, Indian Head, Maryland	Construction time:	25 weeks
Media:	Soil and Solid Waste - Area A and Upland Area	Operation time:	30 years
		Discount Rate:	5.2%
		O&M Contingency:	20%

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$2,524,225	Cost associated with construction of soil cover system, ICs, planning, and relocation of 3 GW monitoring wells	Capital	1.00	$2,524,225
1	$50,137	Two biannual field inspections, mowings, and quarterly samplings	O&M	1.05	$47,659
2	$50,137	Two biannual field inspections, mowings, and quarterly samplings	O&M	1.11	$45,303
3	$50,137	Two biannual field inspections, mowings, and quarterly samplings	O&M	1.16	$43,063
4	$17,493	Two biannual field inspections, mowings and annual sampling	O&M	1.22	$14,283
5	$77,978	Two biannual field inspections, mowings, 5 year cover repair, groundwater sampling and five year review	O&M, Periodic	1.29	$60,519
6	$6,612	Two biannual field inspections and mowings	O&M	1.36	$4,878
7	$6,612	Two biannual field inspections and mowings	O&M	1.43	$4,637
8	$6,612	Two biannual field inspections and mowings	O&M	1.50	$4,408
9	$6,612	Two biannual field inspections and mowings	O&M	1.58	$4,190
10	$67,097	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	1.66	$40,415
11	$6,612	Two biannual field inspections and mowings	O&M	1.75	$3,786
12	$6,612	Two biannual field inspections and mowings	O&M	1.84	$3,599
13	$6,612	Two biannual field inspections and mowings	O&M	1.93	$3,421
14	$6,612	Two biannual field inspections and mowings	O&M	2.03	$3,252
15	$67,097	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	2.14	$31,366
16	$6,612	Two biannual field inspections and mowings	O&M	2.25	$2,938
17	$6,612	Two biannual field inspections and mowings	O&M	2.37	$2,793
18	$6,612	Two biannual field inspections and mowings	O&M	2.49	$2,655
19	$6,612	Two biannual field inspections and mowings	O&M	2.62	$2,524
20	$67,097	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	2.76	$24,344
21	$6,612	Two biannual field inspections and mowings	O&M	2.90	$2,280
22	$6,612	Two biannual field inspections and mowings	O&M	3.05	$2,168
23	$6,612	Two biannual field inspections and mowings	O&M	3.21	$2,061
24	$6,612	Two biannual field inspections and mowings	O&M	3.38	$1,959
25	$67,097	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	3.55	$18,893
26	$6,612	Two biannual field inspections and mowings	O&M	3.74	$1,770
27	$6,612	Two biannual field inspections and mowings	O&M	3.93	$1,682
28	$6,612	Two biannual field inspections and mowings	O&M	4.13	$1,599
29	$6,612	Two biannual field inspections and mowings	O&M	4.35	$1,520
30	$82,097	Two biannual field inspections, mowings, sampling and five year review and site closure.	O&M, Periodic, Site Closure	3.55	$23,117
CAPITAL COST	**$2,524,225**				
2007 Dollar LIFETIME O&M	**$874,330**		**Lifetime Present Worth O&M**		**$488,497**
TOTAL IMPLEMENTATION COST	**$3,398,555**		**TOTAL PRESENT WORTH**		**$3,012,723**

REMEDIAL ALTERNATIVE 3 RCRA C-Equivalent Cap, Groundwater Monitoring, and ICs	LOCATION: Site 11, Caffee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Solid Waste and Contaminated Soil	Construction time: **33** weeks Operation time: **30** years Post Remediation Monitoring: Included in the groundwater monitoring component

DESCRIPTION OF ALTERNATIVE:

RCRA C Cap and implementation of operation and maintenance and ICs for 30 years, including biannual field inspection and mowing, five-yearly cover repair, and five-year reviews.

ASSUMPTIONS:

	Square Feet (SF)		acres	
1) Area of Attainment	121,078		2.78	
2) Area of Excavation	0		0	
	Cubic feet (CF)		Cubic yards (CY)	tons (0.058 tons/CF)
3) Site 17 excavated site soil from NTCRA will be consolidated under the soil cap:	12960	or	480	752
4) Total cut and fill volume to crate the base grade fro the landfill cover is (from Figure 4-1 FS):	63	CY	99	tons
5) The soil cap area is approx.	121,078	SF	2.78	acres
6) Required soil fill material to install the 2' soil cover and to create the base grade for the cover is approx.			8969	CY
7) Total fill material in place:			9032	CY

8) No wetland mitigation.

9) Swelling factor: 10%

10) Perimeter of the soil cover area is approx. 1,320.00 **Feet (ft)**

11) Surface water management would be accomplished through rip rap ditches along the perimeter of the cover.

12) Asphalt paved area requiring demolition 780 **SF**

13) Length of shoreline for stabilization: 900 LF; Width: 15 ft; Low tide water line: 6 ft

14) Volume of shoreline debris to be removed and rip-rap to be installed (to low tide water line) assuming % void of : 50% 40500 CF 2349 tons

15) Sampling includes three years of quarterly sampling, and annual sampling in years 4 & 5.

16) Wells to be abandoned: 3 Wells to be installed: 3 Wells to be sampled: 7

17) Sources of costs are 2004 RS Means Site Work & Landscape Cost Data, RS Means Environmental Remediation Cost Data - Unit Price, vendor quotes, and professional judgment based on similar projects.

18) Inflation factor to adjust 2004 cost to 2007 cost: 4% (applied to the total capital cost)

Cost Component	Qty	Unit	Cost Source/Assumptions	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Institutional Controls/Planning												**$5,000.00**
Site-Specific LUC	1	lump sum	Allowance		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Permitting, Planning, and Reporting												**$12,500.00**
Health and Safety Plan	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
FSP, QAPP, and DQOs	1	lump sum	Professional Judgment		$7,500.00	$7,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,500.00
Site Preparation				**10**								**$18,306.91**
Site clearing (dozer light)	2.78	acre	M 31 11 10 10 0020, CCI Mod	5	$2,500.00	$6,950.00	$1,297.95	$3,608.30	$0.00	$0.00	$0.00	$10,558.30
Site demolition (road demolition - assume asphalt paved)	780	SY	M 02 41 13 17 5010	2	$2.29	$1,786.20	$1.57	$1,224.60	$0.00	$0.00	$0.00	$3,010.80
Survey	3	days	M02 21 13 13 0200	3	$1,509.24	$4,527.72	$70.03	$210.09	$0.00	$0.00	$0.00	$4,737.81
Construction of RCRA Equivalent Subtitle C Cap				**92**								**$600,320.64**
Vegetative and Protective Layer - 18" common earth 6" top soil												
Borrow, loading, and spreading - top soil, shovel, 1CY bucket (6" thick)	2,242	CY	M 31 23 23 15 7000	4	$0.78	$1,748.90	$1.32	$2,959.68	$20.00	$44,843.70	$0.00	$49,552.29
Borrow, loading, and spreading - common earth, shovel, 1CY bucket (18" thick)	6,727	CY	M 31 23 23 15 4000, CCI Modified	9	$0.78	$5,246.71	$1.65	$11,098.82	$13.00	$87,445.22	$0.00	$103,790.75
Grading - large area	8,648	SY	M 31 22 16 10 0100	5	$0.18	$1,556.72	$0.19	$1,643.20	$0.00	$0.00	$0.00	$3,199.92
Compaction - sheepsfoot, 12" lifts, 4 passes	8,969	CY	M 31 23 23 23 5720	7	$0.19	$1,704.06	$0.49	$4,394.68	$0.00	$0.00	$0.00	$6,098.74
Trenching for dikes and ditches- 1-4' deep, 3/8 CY backhoe	1,320	CY	M 31 23 16 13 0050	9	$4.23	$5,583.60	$2.15	$2,838.00	$0.00	$0.00	$0.00	$8,421.60
Drainage Layer - a composite drainage net (CDN) (including installation)	121,078	SF	CH2M HILL Estimate	2	$0.00	$0.00	$0.00	$0.00	$1.13	$136,212.75	$0.00	$136,212.75
Synthetic barrier 40 mil HDPE	121,078	SF	E 33 08 0571	49	$1.02	$123,499.56	$0.21	$25,426.38	$0.40	$48,431.20	$0.00	$197,357.14
GCL (including installation)	121,078	SF	E 33 08 0508	2	$0.12	$14,529.36	$0.09	$10,897.02	$0.92	$111,391.76	$0.00	$136,818.14
Trenching for dikes and ditches- 1-4' deep, 3/8 CY backhoe	1,320	CY	M 31 23 16 13 0050	9	$4.23	$5,583.60	$2.15	$2,838.00	$0.00	$0.00	$0.00	$8,421.60
Hydroseeding	121	M.SF	M 02920 320 2400	2	$11.65	$1,410.56	$6.82	$825.75	$42.86	$5,189.40	$0.00	$7,425.71
Shoreline Stabilization				**60**								**$480,695.00**
Site Preparation												
Light Clearing	0.15	acre	$3,000 /AC	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$450.00	$450.00
Install Temp ECM	2,230	SY		CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$4.00	$8,920.00	$0.00	$8,920.00
Silt curtain (Inst/Rem)	5,200	SF	$3.15/SF	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$16,380.00	$16,380.00
Shoreline Stabilization												
Surface debris removal	450	CY	$20.00/ CY - 2.0 UC Mult for Safety	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18,000.00	$18,000.00
Transportation/Disposal of Removed Surface Rubble	810	TN	$60.00/ Ton - Assume 1.8 T/CY	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$48,600.00	$48,600.00
Install Geotextile	3,800	SY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9,500.00	$9,500.00
Install Rock Fill	3500	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$157,500.00	$157,500.00
Crane/Clamshell	60	days		CH2M HILL CCI	$0.00	$0.00	$1,700.00	$102,000.00	$0.00	$0.00	$0.00	$102,000.00
General Fill	2400	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$15.00	$36,000.00	$0.00	$36,000.00
Install Topsoil	325	CY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$25.00	$8,125.00	$0.00	$8,125.00
High Velocity ECM	2230	SY	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$25.00	$55,750.00	$0.00	$55,750.00
Install Vegetation				CH2M HILL CCI								
Install Upland Wetland Shrubs (6' c-c)	486	EACH	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$20.00	$9,720.00	$0.00	$9,720.00
Install Upland Trees (10' c-c)	175	EACH	Material + installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$50.00	$8,750.00	$0.00	$8,750.00
Seeding	0.5	acre			$0.00	$0.00	$0.00	$0.00	$2,000.00	$1,000.00	$0.00	$1,000.00

REMEDIAL ALTERNATIVE 3 RCRA C-Equivalent Cap, Groundwater Monitoring, and ICs	LOCATION: Site 11, Caffee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Solid Waste and Contaminated Soil	Construction time: **33** weeks Operation time: **30** years Post Remediation Monitoring: Included in the groundwater monitoring component

Cost Component	Qty	Unit	Cost Source/Assumptions	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
MEC Avoidance Survey and Screening (only during intrusive activities)												**$42,753.00**
Mob/Demob	2	person	CH2M HILL Rates		$750.00	$1,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,500.00
OE Avoidance Team	30	day	CH2M HILL Rates		$1,170.10	$35,103.00	$0.00	$0.00	$0.00	$0.00	$0.00	$35,103.00
OE Avoidance Equipment	30	day	CH2M HILL Rates		$0.00	$0.00	$85.00	$2,550.00	$0.00	$0.00	$0.00	$2,550.00
OE Avoidance Report												
OE Avoidance Plan (Draft and Final)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
Health and Safety Plan (including briefing)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
After Action Report	1	each	CH2M HILL Rates		$1,600.00	$1,600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,600.00
Abandonment and Installation of Monitoring Wells				**2**								**$2,354.88**
Well abandonment	24	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$22.33	$535.92		$535.92
8" Diameter soil boring for well advancement	24	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$22.33	$535.92		$535.92
2" diameter, 5' PVC well screen	3	Unit	BOA Rates		$0.00	$0.00	$0.00	$0.00	$37.67	$113.00		$113.00
Installation of flush-mounted covers	3	Unit	BOA Rates		$0.00	$0.00	$0.00	$0.00	$258.33	$775.00		$775.00
Well Development	3	hrs	BOA Rates						$96.67	$290.01		$290.01
Well Installation 2" PVC riser, minimum of 6' per each of the 3 wells to be replaced	9	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$11.67	$105.03		$105.03
Construction Oversight												**$263,607.04**
Engineer (P2)	33	weeks	Professional Judgement		$2,450.00	$80,360.00	$0.00	$0.00	$0.00	$0.00	$0.00	$80,360.00
Site Health and Safety (P2)	33	weeks	Professional Judgement		$2,450.00	$80,360.00	$0.00	$0.00	$0.00	$0.00	$0.00	$80,360.00
Superintendent (P3)	33	weeks	Professional Judgement		$3,136.80	$102,887.04	$0.00	$0.00	$0.00	$0.00	$0.00	$102,887.04
Preconstruction Submittals												**$140,803.75**
Preconstruction survey, design basis, pre-draft, draft, and final design, specifications, MEC avoidance plan, and H&S plans	1	lump sum	10% of total construction cost		$140,803.75	$140,803.75	$0.00	$0.00	$0.00	$0.00	$0.00	$140,803.75
General Conditions												**$140,803.75**
Decontamination, temp. facilities, sed. & erosion control, temp. fence, etc.	1	lump sum	10% of total construction cost		$140,803.75	$140,803.75	$0.00	$0.00	$0.00	$0.00	$0.00	$140,803.75
Contractor Overhead and Profit												**$211,205.62**
Home office cost, etc.	1	lump sum	15% of total construction cost		$211,205.62	$211,205.62	$0.00	$0.00	$0.00	$0.00	$0.00	$211,205.62
Mob/Demob												**$70,401.87**
Mob & demob of equip & personnel	1	lump sum	10% of total construction cost		$70,401.87	$70,401.87	$0.00	$0.00	$0.00	$0.00	$0.00	$70,401.87
2004 SUBTOTAL CAPITAL COST						**$1,058,652.02**		**$172,514.53**		**$564,133.92**	**$250,430.00**	**$2,045,730.47**
2007 SUBTOTAL CAPITAL COST (ADJUSTED WITH INFLATION FACTOR)						**$1,100,998.11**		**$179,415.11**		**$586,699.28**	**$260,447.20**	**$2,127,559.69**
Scope Contingency	30%											**$638,267.91**
Bid Contingency	20%											**$425,511.94**
TOTAL CAPITAL COST												**$3,191,339.54**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Cover Maintenance												**$3,306.09**
Biannual mowing - tractor with rotary mower	121	M.SF	M 02935 300 1660		$12.25	$1,483.21	$10.10	$1,222.89	$0.00	$0.00	$0.00	$2,706.09
Biannual inspection	8	hrs	E 99 11 0403		$75.00	$600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.00
Cover Repair - every five years												**$63,826.79**
Assume 2% of total capital cost	1	lump sum	Professional Judgment		$63,826.79	$63,826.79	$0.00		$0.00	$0.00	$0.00	$63,826.79
Groundwater Sampling and Analysis												**$10,881.14**
Sample Collection												**$2,629.66**
Sample collection - 2 crew, 10 hrs/day, $50/hr	2	days	Professional Judgment		$1,000.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,000.00
Disposable and decon materials per sample	7	samples	E 33 02 0401, 33 02 0402, 33 02 0561		$0.00	$0.00	$0.00	$0.00	$24.90	$174.30	$0.00	$174.30
Equipment Rental	2	days	E 33 02 0573, 33 02 0578		$0.00	$0.00	$227.68	$455.36	$0.00	$0.00	$0.00	$455.36
Lab Analysis (30% QA/QC)												**$3,251.48**
Metals (total and dissolved)	19	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,601.48	$2,601.48
Chloride, nitrite/nitrate, sulfate	10	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$650.00	$650.00
Report	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00		$0.00	$0.00	$0.00	**$5,000.00**
Five-Year Review												**$10,000.00**
Report - Engineer	1	lump sum	Professional Judgment		$10,000.00	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10,000.00
Site Closure												**$15,000.00**
Report development	1	lump sum	Allowance		$15,000.00	$15,000.00	$0.00		$0.00	$0.00	$0.00	$15,000.00

PRESENT WORTH CALCULATION

REMEDIAL ALTERNATIVE 3 - RCRA C CAP, LONG-TERM GROUNDWATER MONITORING, AND ICs

Location:	Site 11, Caffee Road Landfill, NSF-IH, Indian Head, Maryland	Construction time:	33 weeks
Media:	Soil and Solid Waste - Area A and Upland Area	Operation time:	30 years
		Discount Rate:	5.2%
		O&M Contingency:	20%

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$3,191,340	Capital cost for constructing a soil cap system	Capital	1.00	$3,191,340
1	$50,137	Two biannual field inspections, mowings, and quarterly sampling	O&M	1.05	$47,659
2	$50,137	Two biannual field inspections, mowings, and quarterly sampling	O&M	1.11	$45,303
3	$50,137	Two biannual field inspections, mowings, and quarterly sampling	O&M	1.16	$43,063
4	$17,493	Two biannual field inspections, mowings and annual sampling	O&M	1.22	$14,283
5	$91,320	Two biannual field inspections, mowings, 5 year cover repair, annual sampling and five year review	O&M, Periodic	1.29	$70,874
6	$6,612	Two biannual field inspections and mowings	O&M	1.36	$4,878
7	$6,612	Two biannual field inspections and mowings	O&M	1.43	$4,637
8	$6,612	Two biannual field inspections and mowings	O&M	1.50	$4,408
9	$6,612	Two biannual field inspections and mowings	O&M	1.58	$4,190
10	$80,439	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	1.66	$48,452
11	$6,612	Two biannual field inspections and mowings	O&M	1.75	$3,786
12	$6,612	Two biannual field inspections and mowings	O&M	1.84	$3,599
13	$6,612	Two biannual field inspections and mowings	O&M	1.93	$3,421
14	$6,612	Two biannual field inspections and mowings	O&M	2.03	$3,252
15	$80,439	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	2.14	$37,604
16	$6,612	Two biannual field inspections and mowings	O&M	2.25	$2,938
17	$6,612	Two biannual field inspections and mowings	O&M	2.37	$2,793
18	$6,612	Two biannual field inspections and mowings	O&M	2.49	$2,655
19	$6,612	Two biannual field inspections and mowings	O&M	2.62	$2,524
20	$80,439	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	2.76	$29,184
21	$6,612	Two biannual field inspections and mowings	O&M	2.90	$2,280
22	$6,612	Two biannual field inspections and mowings	O&M	3.05	$2,168
23	$6,612	Two biannual field inspections and mowings	O&M	3.21	$2,061
24	$6,612	Two biannual field inspections and mowings	O&M	3.38	$1,959
25	$80,439	Two biannual field inspections, mowings, 5 year cover repair, and five year review	O&M, Periodic	3.55	$22,650
26	$6,612	Two biannual field inspections and mowings	O&M	3.74	$1,770
27	$6,612	Two biannual field inspections and mowings	O&M	3.93	$1,682
28	$6,612	Two biannual field inspections and mowings	O&M	4.13	$1,599
29	$6,612	Two biannual field inspections and mowings	O&M	4.35	$1,520
30	$95,439	Two biannual field inspections, mowings, and five year review and site closure.	O&M, Periodic, Site Closure	3.55	$26,874
CAPITAL COST	**$3,191,340**				
2007 Dollar LIFETIME O&M	**$970,395**		**Lifetime Present Worth O&M**		**$532,878**
TOTAL IMPLEMENTATION COST	**$4,161,734**		**TOTAL PRESENT WORTH**		**$3,724,217**

SOIL REMEDIAL ALTERNATIVE 4 Excavation, Off-site Disposal, and Wetland Creation	LOCATION: Site 11, Caffee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Solid Waste and Contaminated Soil	Construction time: 12 weeks Operation time: NA Post Remediation Monitoring: none

DESCRIPTION OF ALTERNATIVE:

Excavation of soil area of attainment containing surface and buried metal debris, buried non metal debris, and contaminated soil; off-site disposal of the excavated material to a permitted landfill; and, creation of wetland.

ASSUMPTIONS:

1) The AA is approx. 121078 SF 2.78 acres
2) Volume and mass of excavation - in place (Figure 4-2 of the FS) to be disposed off-site: 29392 CY or 46,028 tons (assume bulk density of 1.85 kg/L)
3) Total volume of backfill material (Figure 4-2 of the FS): 14581 CY
4) Total volume of top soil backfill (6"): 2242 CY
5) Total volume of earthen material fill: 12339 CY
6) Site 17 NTCRA Excavated material 480 CY or 752 tons
7) Road demolition: 780 CY
8) Swelling factor: 10%
9) All 7 existing monitoring wells are be abandoned.
10) Area requiring wetlands mitigation 121,078 SF 2.78 acres
11) Neither ICs nor five-year reviews would required since waste would be removed. O&M activities are limited to the care of the created wetland through biannual field inspections and vegetation replanting.
12) Sources of costs are 2004 RS Means Site Work & Landscape Cost Data, RS Means Environmental Remediation Cost Data - Unit Price, vendor quotes, and professional judgment based on similar projects.
13) Cost escalation factor to adjust 2004 cost to 2007/2008 cost: 4% (applied to the total capital cost)

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Site Preparation				**10**								**$16,960.13**
Site clearing (dozer light)	2.78	acre	M 31 11 10 10 0020	5	$1,852.14	$5,148.94	$1,349.87	$3,752.63	$0.00	$0.00	$0.00	$8,901.57
Site demolition (road demolition - assume asphalt paved)	780	SY	M 02 41 13 17 5010	2	$2.38	$1,857.65	$1.63	$1,273.58	$0.00	$0.00	$0.00	$3,131.23
Survey	3	days	M02 21 13 13 0200	3	$1,569.61	$4,708.83	$72.83	$218.49	$0.00	$0.00	$0.00	$4,927.32
Excavation and Backfill				**38**								**$746,184.21**
Excavation, bulk, dozer, piled, 300 HP 50' haul common earth	29,392	CY	M 31 23 16 42 5020 adjusted (4.0 Multiplier per CCI)	18	$1.24	$36,446.08	$3.68	$108,162.56	$0.00	$0.00	$0.00	$144,608.64
Dewatering of excavated material (assumed - 75% of excavated material)	22,044	CY	CH2M HILL Estimate (stockpile passive dewatering, mix dry & wet, no free liquids)		$5.75	$126,753.00	$7.50	$165,330.00	$4.00	$88,176.00	$0.00	$380,259.00
Borrow, loading, and spreading - common earth, shovel, 1CY bucket (18" thick)	12,339	CY	M 31 23 23 15 4000	15	$0.81	$10,009.25	$1.72	$21,173.41	$10.17	$125,500.55	$0.00	$156,683.21
Borrow, loading, and spreading - top soil, shovel, 1CY bucket (6" thick)	2,242	CY	M 31 23 23 15 7000	4	$0.81	$1,818.86	$1.37	$3,078.07	$20.00	$44,843.70	$0.00	$49,740.64
Grading - large area	13,453	SF	M 31 22 16 10 0100	7	$0.18	$2,421.56	$0.19	$2,556.09	$0.00	$0.00	$0.00	$4,977.65
Compaction - sheepsfoot, 12" lifts, 4 passes	14,581	CY	M 31 23 23 23 5720	12	$0.19	$2,770.39	$0.49	$7,144.69	$0.00	$0.00	$0.00	$9,915.08
MEC Avoidance Survey and Screening (only during excavation activities)												**$139,281.30**
Mob/Demob	2	person	CH2M HILL Rates		$750.00	$1,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,500.00
OE Avoidance Team	5	day	CH2M HILL Rates		$1,170.10	$5,850.50	$0.00	$0.00	$0.00	$0.00	$0.00	$5,850.50
OE Excavation Team	38	day	CH2M HILL Rates		$1,583.80	$60,184.40	$0.00	$0.00	$0.00	$0.00	$0.00	$60,184.40
OE Disposal Team	38	day	CH2M HILL Rates		$1,468.80	$55,814.40	$0.00	$0.00	$0.00	$0.00	$0.00	$55,814.40
OE Avoidance Equipment	5	day	CH2M HILL Rates		$0.00	$0.00	$85.00	$425.00	$0.00	$0.00	$0.00	$425.00
OE Avoidance Report												
OE Avoidance Plan (Draft and Final)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
Health and Safety Plan (including briefing)	1	each	CH2M HILL Rates		$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
After Action Report	1	each	CH2M HILL Rates		$1,600.00	$1,600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,600.00
Lodging and Per diem	81	day			$0.00	$0.00	$0.00	$0.00	$147.00	$11,907.00	$0.00	$11,907.00
Off-site Transportation and Disposal				**Concurrent w/ excavation**								**$4,358,991.73**
Landfill Fees	46,028	ton	E 33 19 7269		$0.00	$0.00	$0.00	$0.00	$90.33	$4,157,697.68	$0.00	$4,157,697.68
Dump Truck Transportation Minimum Charge (16.5 CY travel 23.5 miles)	45,264	miles	E 33 19 0210		$0.00	$0.00	$0.00	$0.00	$2.85	$129,001.49	$0.00	$129,001.49
Loading soil into truck	32,331	CY	E 33 19 0150		$0.77	$24,882.09	$1.47	$47,410.47	$0.00	$0.00	$0.00	$72,292.56
Site 17 Excavation and transport of soil to offsite landfill				**Concurrent w/ excavation**								**$70,875.36**
Landfill Fees (non hazardous)	752	ton	E 33 19 7269		$0.00	$0.00	$0.00	$0.00	$90.33	$67,928.16	$0.00	$67,928.16
Dump Truck Transportation Minimum Charge	672	miles	E 33 19 0210		$0.00	$0.00	$0.00	$0.00	$2.85	$1,915.20	$0.00	$1,915.20
Loading soil into truck	480	CY	E 33 19 0150		$0.74	$355.20	$1.41	$676.80	$0.00	$0.00	$0.00	$1,032.00
Site Restoration and Surface Water Management				**9**								**$52,437.71**
Rip rap , 3' bottom, 3' deep, 2:1 side slope	1,320	LF	E 33 05 0804	7	$3.57	$4,712.40	$5.78	$7,629.60	$24.75	$32,670.00	$0.00	$45,012.00
Hydroseeding	121	M.SF	M 02920 320 2400	2	$11.65	$1,410.56	$6.82	$825.75	$42.86	$5,189.40	$0.00	$7,425.71
Drilling				**1**								**$70,750.48**
Well abandonment	56	LF	BOA Rates		$0.00	$0.00	$0.00	$0.00	$22.33	$1,250.48		$1,250.48
Wetlands Mitigation				**2**								**$69,500.00**
Planting of native wetland species	2.78	acre	Professional Judgment	2	$0.00	$0.00	$0.00	$0.00	$25,000.00	$69,500.00	$0.00	$69,500.00
Construction Oversight												**$96,441.60**
Engineer (P2)	12	weeks	Professional Judgement	60	$2,450.00	$29,400.00	$0.00	$0.00	$0.00	$0.00	$0.00	$29,400.00
Site Health and Safety (P2)	12	weeks	Professional Judgement	60	$2,450.00	$29,400.00	$0.00	$0.00	$0.00	$0.00	$0.00	$29,400.00
Superintendent (P3)	12	weeks	Professional Judgement	60	$3,136.80	$37,641.60	$0.00	$0.00	$0.00	$0.00	$0.00	$37,641.60

SOIL REMEDIAL ALTERNATIVE 4 Excavation, Off-site Disposal, and Wetland Creation		LOCATION: Site 11, Caffee Road Landfill NSF-IH, Indian Head, Maryland					MEDIA: Solid Waste and Contaminated Soil		Construction time: 12 weeks Operation time: NA Post Remediation Monitoring: none			
Preconstruction Submittals												**$132,762.31**
Preconstruction survey, design basis, pre-draft, draft, and final design, specifications, and H&S plans	1	lump sum	15% of total construction cost		$132,762.31	$132,762.31	$0.00	$0.00	$0.00	$0.00	$0.00	$132,762.31
Draft and Final ESS	1	lump sum	4% of total construction cost		$35,403.28	$35,403.28	$0.00	$0.00	$0.00	$0.00	$0.00	$35,403.28
General Conditions												**$88,508.21**
Decontamination, temp. facilities, sed. & erosion control, temp. fence, etc.	1	lump sum	10% of total construction cost		$88,508.21	$88,508.21	$0.00	$0.00	$0.00	$0.00	$0.00	$88,508.21
Contractor Overhead and Profit												**$132,762.31**
Home office cost, etc.	1	lump sum	15% of total construction cost		$132,762.31	$132,762.31	$0.00	$0.00	$0.00	$0.00	$0.00	$132,762.31
Mob/Demob												**$44,254.10**
Mob & demob of equip & personnel	1	lump sum	5% of total construction cost		$44,254.10	$44,254.10	$0.00	$0.00	$0.00	$0.00	$0.00	$44,254.10
Site Closure												**$25,000.00**
Report development	1	lump sum	Professional Judgment		$25,000.00	$25,000.00	$0.00		$0.00	$0.00	$0.00	$25,000.00
SUBTOTAL CAPITAL COST						**$880,375.91**		**$369,657.15**		**$4,735,579.67**	**$0.00**	**$6,010,612.73**
2007/2008 SUBTOTAL CAPITAL COST (ADJUSTED WITH ESCALATION FACTOR)						**$915,590.94**		**$384,443.44**		**$4,925,002.85**	**$0.00**	**$6,251,037.24**
Scope Contingency	30%											**$1,803,183.82**
Bid Contingency	20%											**$1,202,122.55**
TOTAL CAPITAL COST												**$9,256,343.60**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Wetlands Maintenance												**$7,550.00**
Biannual inspection	8	hrs	E 99 11 0403		$75.00	$600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$600.00
Replanting												
Assume 10% of wetlands mitigation cost per inspection	1	lump sum	Professional Judgment		$6,950.00	$6,950.00	$0.00		$0.00	$0.00	$0.00	$6,950.00
Site Closure												**$15,000.00**
Report development	1	lump sum	Professional Judgment		$15,000.00	$15,000.00	$0.00		$0.00	$0.00	$0.00	$15,000.00

PRESENT WORTH CALCULATION
REMEDIAL ALTERNATIVE 4 - EXCAVATION, OFF-SITE DISPOSAL, AND WETLAND CREATION

Location:	Site 11, Caffee Road Landfill, NSF-IH, Indian Head, Maryland	Construction time:	12 weeks
Media:	Soil and Solid Waste - Area A and Upland Area	Operation time:	30 years
		Discount Rate:	5.2%
		O&M Contingency:	20%

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$9,256,344	Cost associated with excavation and disposal, wetlands mitigation, well abandonment and planning	Capital	1.00	$9,256,344
1	$15,100	Two biannual field inspections and replanting	O&M	1.05	$14,354
2	$15,100	Two biannual field inspections and replanting	O&M	1.11	$13,644
3	$15,100	Two biannual field inspections and replanting	O&M	1.16	$12,970
4	$0	NA	NA	1.22	$0
5	$15,000	Site Closure	Periodic	1.29	$11,642
CAPITAL COST	**$9,256,344**				
2007 Dollar LIFETIME O&M	**$72,360**		**Lifetime Present Worth O&M**		**$63,131**
TOTAL IMPLEMENTATION COST	**$9,328,704**		**TOTAL PRESENT WORTH**		**$9,319,474**

SEDIMENT REMEDIAL ALTERNATIVE 2 Long-Term Monitoring and ICs	LOCATION: Site 11, Cafee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Sediments	Construction time: 0 week Operation time: 30 years Post Remediation Monitoring: included in the operation time

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost

DESCRIPTION OF ALTERNATIVE:

ICs and long term monitoring.

Assumptions:

1) Annual monitoring of sediment for total metals for 30 years from six locations along the shoreline.

2) All samples would be analyzed for Zinc. 6 samples

3) Data interpretation and report would be prepared following a sampling event.

4) Five-year reviews and a site closure report

5) Sources of costs are 2004 RS Means Site Work & Landscape Cost Data, RS Means Environmental Remediation Cost Data - Unit Price, vendor quotes, and professional judgment based on similar projects.

6) Sampling includes one year of quarterly sampling, annual sampling in years 2, 3, 4 & 5, and sampling every 5 years thereafter for the remaining timeframe up to 30 years

7) Cost escalation factor to adjust 2004 cost to 2008 cost: 4% (applied to the total capital cost)

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Institutional Controls/Planning												**$5,000.00**
Site-Specific LUC	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Permitting, Planning, and Reporting												**$7,500.00**
Health and Safety Plan	1	lump sum	Professional Judgment		$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,500.00
FSP, QAPP, and DQOs	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
SUBTOTAL CAPITAL COST						**$12,500.00**		**$0.00**		**$0.00**	**$0.00**	**$12,500.00**
2008 SUBTOTAL CAPITAL COST (ADJUSTED WITH escalation FACTOR)						**$13,000.00**		**$0.00**		**$0.00**	**$0.00**	**$13,000.00**
Scope Contingency	25%											**$3,125.00**
Bid Contingency	10%											**$1,250.00**
TOTAL CAPITAL COST												**$17,375.00**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Sampling and Analysis												
Sample Collection												**$2,680.74**
Sample collection - 2 crew, 10 hrs/day, $50/hr	2	days	Professional Judgment		$1,000.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,000.00
Disposable and decon materials per sample	8	samples	E 33 02 0401, 33 02 0402, 33 02 0561		$0.00	$0.00	$0.00	$0.00	$25.90	$207.17	$0.00	$207.17
Equipment Rental	2	days	E 33 02 0573, 33 02 0578		$0.00	$0.00	$227.68	$473.57	$0.00	$0.00	$0.00	$473.57

SEDIMENT REMEDIAL ALTERNATIVE 2 Long-Term Monitoring and ICs	LOCATION: Site 11, Cafee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Sediments	Construction time: 0 week Operation time: 30 years Post Remediation Monitoring: included in the operation time

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
Lab Analysis												**$204.42**
Metals by graphite furnace (individual element) (7000 series)	8	samples	BOA Rates 2005		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$204.42	$204.42
Data Interpretation												**$1,750.00**
Report	1	lump sum	Professional Judgment		$1,750.00	$1,750.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,750.00
Five-Year Review												**$6,000.00**
Report	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Field Inspection	1	lump sum	Professional Judgment		$1,000.00	$1,000.00	$0.00	$0.00		$0.00	$0.00	$1,000.00
Site Closure												**$15,000.00**
Report development	1	lump sum	Professional Judgment		$15,000.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$15,000.00

PRESENT WORTH CALCULATION
SEDIMENT REMEDIAL ALTERNATIVE 2

Location:	Site 11, Caffee Road Landfill, NSF-IH, Indian Head, Maryland	Construction time:	1 week
Media:	Sediment	Operation time:	30 years
		Discount Rate:	5.2%
		O&M Contingency:	20%

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$17,375	Capital cost	Capital	1.00	$17,375
1	$18,541	Quarterly sediment sampling for zinc	O&M	1.05	$17,624
2	$4,635	Annual sampling	O&M	1.11	$4,188
3	$4,635	Annual sampling	O&M	1.16	$3,981
4	$4,635	Annual sampling	O&M	1.22	$3,784
5	$10,635	Annual sampling and five-year review	O&M, Periodic	1.29	$8,254
6	$0	Annual sampling	NA	1.36	$0
7	$0	Annual sampling	NA	1.43	$0
8	$0	Annual sampling	NA	1.50	$0
9	$0	Annual sampling	NA	1.58	$0
10	$10,635	Annual sampling and five-year review	O&M, Periodic	1.66	$6,406
11	$0	Annual sampling	NA	1.75	$0
12	$0	Annual sampling	NA	1.84	$0
13	$0	Annual sampling	NA	1.93	$0
14	$0	Annual sampling	NA	2.03	$0
15	$10,635	Annual sampling and five-year review	O&M, Periodic	2.14	$4,972
16	$0	Annual sampling	NA	2.25	$0
17	$0	Annual sampling	NA	2.37	$0
18	$0	Annual sampling	NA	2.49	$0
19	$0	Annual sampling	NA	2.62	$0
20	$10,635	Annual sampling and five-year review	O&M, Periodic	2.76	$3,859
21	$0	Annual sampling	NA	2.90	$0
22	$0	Annual sampling	NA	3.05	$0
23	$0	Annual sampling	NA	3.21	$0
24	$0	Annual sampling	NA	3.38	$0
25	$10,635	Annual sampling and five-year review	O&M, Periodic	3.55	$2,995
26	$0	Annual sampling	NA	3.74	$0
27	$0	Annual sampling	NA	3.93	$0
28	$0	Annual sampling	NA	4.13	$0
29	$0	Annual sampling	NA	4.35	$0
30	$15,000	Annual sampling and site closure.	O&M, Periodic, Site Closure	4.58	$3,278
CAPITAL COST	**$17,375**				
2005 Dollar LIFETIME O&M	**$120,746**		**Lifetime Present Worth O&M**		**$71,210**
TOTAL IMPLEMENTATION COST	**$138,121**		**TOTAL PRESENT WORTH**		**$88,585**

SEDIMENT REMEDIAL ALTERNATIVE 3 In Situ Capping and ICs	LOCATION: Site 11, Cafee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Sediments	Construction time: **1** week Operation time: **30** years Post Remediation Monitoring: included in the operation time

DESCRIPTION OF ALTERNATIVE:
Insitu capping of contaminated sediments using geotextile and gravel blanket. ICs and long term monitoring.

Assumptions:

	square feet	acres
1) Insitu Capping (gravel blanket)	3,750.00	0.09
2) Thickness of cap	1.00	ft

3) Annual monitoring of sediment for total metals for 30 years from six locations along the shoreline.

4) Five-year reviews and a site closure report.

5) Sources of costs are 2004 RS Means Site Work & Landscape Cost Data, RS Means Environmental Remediation Cost Data - Unit Price, vendor quotes, and professional judgment based on similar projects.

6) Cost escalation factor to adjust 2004 cost to 2008 cost: 4% (applied to the total capital cost)

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Institutional Controls/Planning												**$5,000.00**
Site-Specific LUC	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Permitting, Planning, and Reporting												**$7,500.00**
Health and Safety Plan	1	lump sum	Professional Judgment		$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,500.00
FSP, QAPP, and DQOs	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Site Preparation				**1**								**$845.20**
Site clearing (dozer light)	0.10	acre	M 022030 200 0500		$239.00	$23.90	$430.00	$43.00	$0.00	$0.00	$0.00	$66.90
Minimum fees		lump sum	200%		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$133.80	$133.80
Survey	1	days	M 01103 700 1100	1	$585.00	$585.00	$59.50	$59.50	$0.00	$0.00	$0.00	$644.50
Insitu Capping				**3**								**$29,897.50**
Cobbles	280	CY	Material + Installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$50.00	$14,000.00	$0.00	$14,000.00
Pea Gravel	140	CY	Material + Installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$40.00	$5,600.00	$0.00	$5,600.00
Crane with Clamshell	3	days	Equipment + Labor	CH2M HILL CCI	$0.00	$0.00	$1,700.00	$5,100.00	$0.00	$0.00	$0.00	$5,100.00
Silt Curtain (Insrt/Remove)	1650	SF	Material + Installation	CH2M HILL CCI	$0.00	$0.00	$0.00	$0.00	$3.15	$5,197.50	$0.00	$5,197.50
General Conditions												**$3,824.27**
Decontamination, temp. facilities, sed. & erosion control, temp. fence, etc.	1	lump sum	10% of total construction cost		$3,824.27	$3,824.27	$0.00	$0.00	$0.00	$0.00	$0.00	$3,824.27
Contractor Overhead and Profit												**$3,824.27**
Home office cost, etc.	1	lump sum	15% of total construction cost		$5,736.41	$5,736.41	$0.00	$0.00	$0.00	$0.00	$0.00	$5,736.41
Mob/Demob												**$3,824.27**
Mob & demob of equip & personnel	1	lump sum	10% of total construction cost		$3,824.27	$3,824.27	$0.00	$0.00	$0.00	$0.00	$0.00	$3,824.27

SEDIMENT REMEDIAL ALTERNATIVE 3 In Situ Capping and ICs	LOCATION: Site 11, Cafee Road Landfill NSF-IH, Indian Head, Maryland	MEDIA: Sediments	Construction time: 1 week Operation time: 30 years Post Remediation Monitoring: included in the operation time

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
SUBTOTAL CAPITAL COST						**$26,493.85**		**$5,202.50**		**$24,797.50**	**$133.80**	**$56,627.65**
2007/2008 SUBTOTAL CAPITAL COST (ADJUSTED WITH ESCALATION FACTOR)						**$27,553.60**		**$5,410.60**		**$25,789.40**	**$139.15**	**$58,892.75**
Scope Contingency	25%											**$14,156.91**
Bid Contingency	10%											**$5,662.76**
TOTAL CAPITAL COST												**$78,712.43**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Five-Year Review												**$6,000.00**
Report	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Field Inspection	1	lump sum	Professional Judgment		$1,000.00	$1,000.00	$0.00	$0.00		$0.00	$0.00	$1,000.00
Site Closure												**$15,000.00**
Report development	1	lump sum	Professional Judgment		$15,000.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$15,000.00

PRESENT WORTH CALCULATION
SEDIMENT REMEDIAL ALTERNATIVE 3

Location:	Site 11, Caffee Road Landfill, NSF-IH, Indian Head, Maryland	Construction time:	1 week
Media:	Sediment	Operation time:	30 years
		Discount Rate:	5.2%
		O&M Contingency:	20%

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$78,712	Capital cost	Capital	1.00	$78,712
1	$0		NA	1.05	$0
2	$0		NA	1.11	$0
3	$0		NA	1.16	$0
4	$0		NA	1.22	$0
5	$6,000	Five-year review	Periodic	1.29	$4,657
6	$0		NA	1.36	$0
7	$0		NA	1.43	$0
8	$0		NA	1.50	$0
9	$0		NA	1.58	$0
10	$6,000	Five-year review	Periodic	1.66	$3,614
11	$0		NA	1.75	$0
12	$0		NA	1.84	$0
13	$0		NA	1.93	$0
14	$0		NA	2.03	$0
15	$6,000	Five-year review	Periodic	2.14	$2,805
16	$0		NA	2.25	$0
17	$0		NA	2.37	$0
18	$0		NA	2.49	$0
19	$0		NA	2.62	$0
20	$6,000	Five-year review	Periodic	2.76	$2,177
21	$0		NA	2.90	$0
22	$0		NA	3.05	$0
23	$0		NA	3.21	$0
24	$0		NA	3.38	$0
25	$6,000	Five-year review	Periodic	3.55	$1,689
26	$0		NA	3.74	$0
27	$0		NA	3.93	$0
28	$0		NA	4.13	$0
29	$0		NA	4.35	$0
30	$15,000	Five-year review and site closure.	Periodic, Site Closure	4.58	$3,278

CAPITAL COST	**$78,712**		
2007/2008 Dollar LIFETIME O&M	**$54,000**	**Lifetime Present Worth O&M**	**$21,864**
TOTAL IMPLEMENTATION COST	**$132,712**	**TOTAL PRESENT WORTH**	**$100,576**